FOREST PEST CONDITIONS IN WISCONSIN

ANNUAL REPORT 1979

DEPARTMENT OF NATURAL RESOURCES
BOX 7921
MADISON, WISCONSIN 53707

FOREST PEST CONDITIONS IN WISCONSIN ANNUAL REPORT - 1979

Compiled and Edited by Donald W. Renlund
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DEPARTMENT OF NATURAL RESOURCES
Division of Resource Management
Bureau of Forestry

OUR MISSION:

To protect and enhance our Natural Resources —
our air, land and water;
our wildlife, fish and forests.

To provide a clean environment
and a full range of outdoor opportunities.

To insure the right of all Wisconsin citizens
to use and enjoy these resources in
their work and leisure.

And in cooperation with all our citizens
to consider the future
and those who will follow us.

Wisconsin
Dept. of Natural Resources

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PREFACE

This record of the activities of forest pests and other destructive agents of growing trees in Wisconsin's forest nurseries, plantations, and natural timber areas was made possible by the dedicated work of pest management personnel in each district and at the Forest Pest Management Laboratory at Nevin Hatchery in Madison. DNR foresters, other department field personnel, cooperators in other public agencies and private forest industry contributed valuable assistance in monitoring the forest lands in all classes of forest ownership.

Preparation of the annual report is the result of the concerted efforts of staff personnel at the Pest Management Laboratory who prepared the final drafts and guided them through typing at the Southern District Office. The finished product was prepared by the Bureau of Office Services.

Many thanks to all who have contributed to the report at any point along the way. Your help was appreciated.

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Department of Natural Resources
Forest Pest Control Personnel - January 1, 1980

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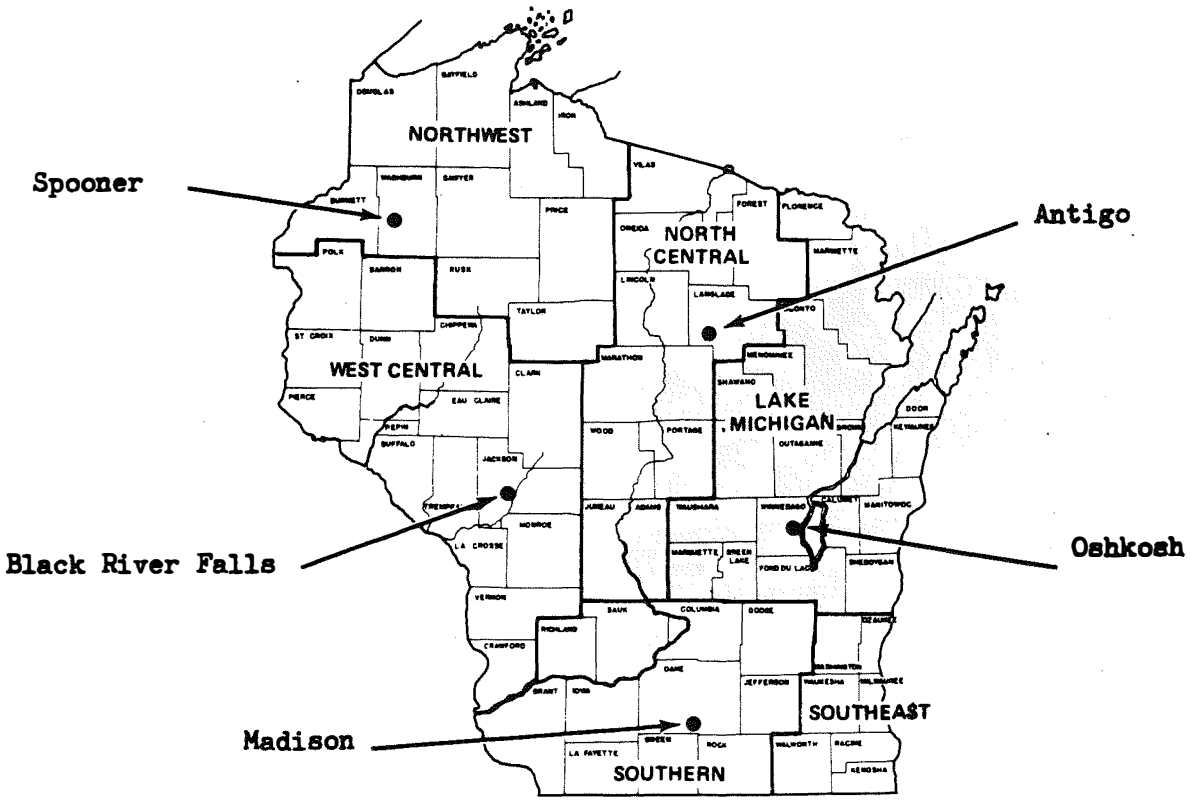

DIPTERA

Balsam Gall Midge - *Paradiplosis tumifex* Gagné

Many populations in Shawano, Langlade, Oneida, Forest and Lincoln counties which were low in 1978 exploded to damage 75% of the new balsam fir needles in 1979. Infestations in Christmas tree plantings caused heavy losses to individual growers.

Insecticide tests using Lindane and Furadan failed to control the midge (Benjamin et al. 1976).

Red Pine Needle Midge - *Thecodiplosis piniresinosae* Kearby

Populations increased from widely scattered pockets in 1978 to high populations scattered over most of the state where red pine is growing in sandy soils (Figure 1). Defoliation was generally light but noticeable with scattered pockets of heavy defoliation of current year's needles. In several pockets (Marquette, Sauk and Richland counties) individual poles of red pine plantings were heavily defoliated while adjacent stands of similar size were lightly defoliated.

An 18 year old planting in Marquette County which was heavily defoliated for the second consecutive year is developing a very unhealthy appearance.

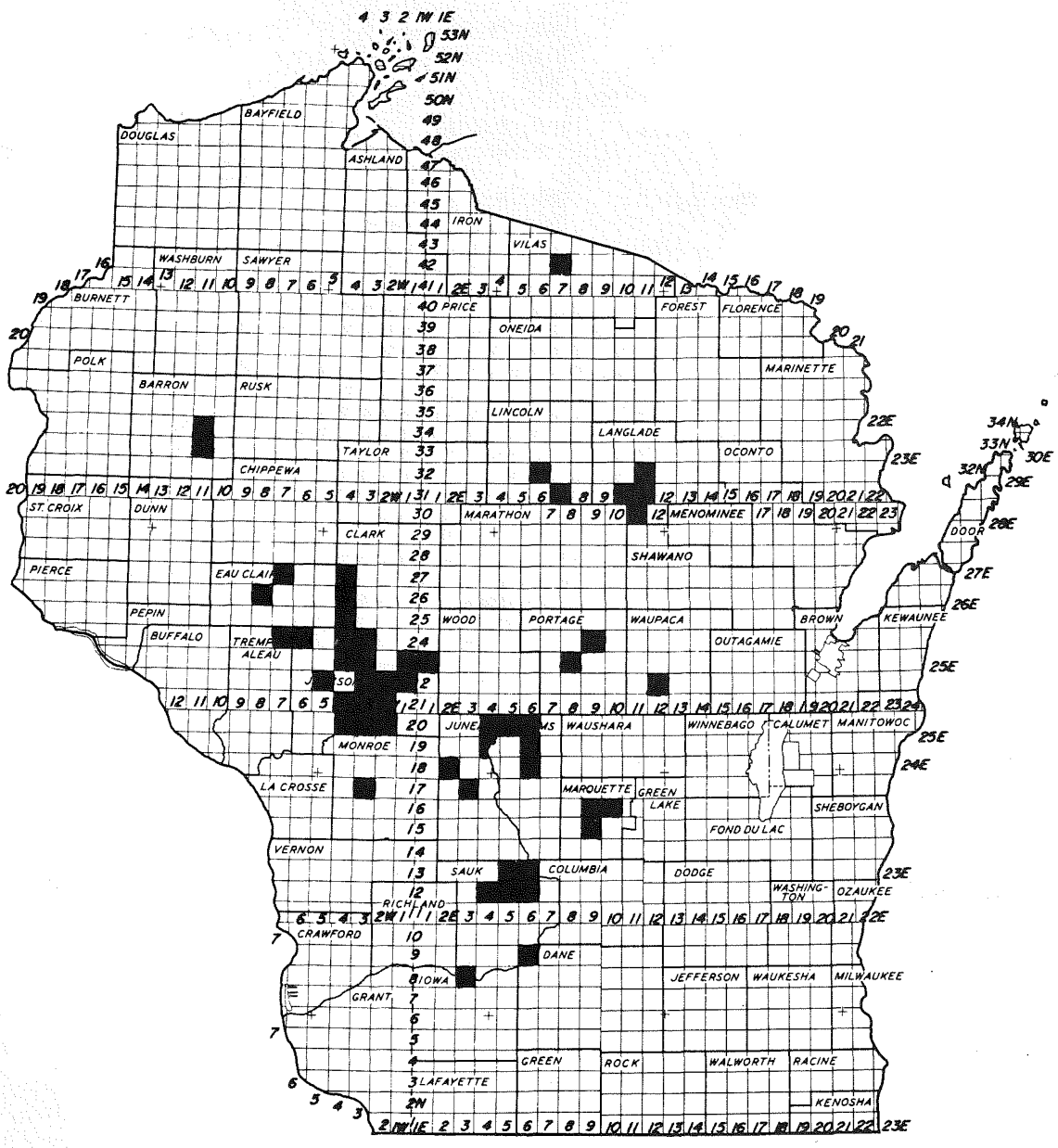

Figure 1. Township Locations of Moderate to Severe Infestations fo the Red Pine Needle Midge, 1979.

HOMOPTERA

Saratoga spittlebug - *Aphrophora saratogensis* (Fitch)

A survey of 1500 acres of planted red pine revealed scattered high populations and resultant heavy branch damage to 225 acres in Vilas, Langlade and Lincoln counties and on the Menominee Reservation.

Sixty acres of red pine on Lincoln County forest land were sprayed with 10 oz. per acre of ULV Cythion.

HYMENOPTERA

European Pine Sawfly - *Neodiprion sertifer* (Geoffroy)

Widespread egg mortality caused population reduction over most of the range of the sawfly in Wisconsin. An infestation in Lafayette that caused heavy defoliation to red pine in 1978 collapsed to a nearly undetectable level. Egg mortality was especially severe on level ground and frost pockets. On individual trees, it was more severe on lower branches of red pines.

In spite of heavy egg mortality, one upland red pine plantation in Walworth County suffered light to heavy defoliation. Many reports of heavy defoliation of red pines were received from Walworth and Waukesha counties.

The range of known infestations is still limited to the southern two tiers of counties (Figure 2). The largest populations are concentrated in the southeastern counties where the species was first observed in Wisconsin in 1972. Concentrations of red pine plantations on the Kettle Moraine State Forest and surrounding private land probably has contributed to rapid population buildup.

Male sawflies have been trapped as far north as Arkdale in Adams County. It is likely that many small infestations have established farther north of the southern two tiers of counties but have not been detected.

For details of biological control of this sawfly see Appendix A.

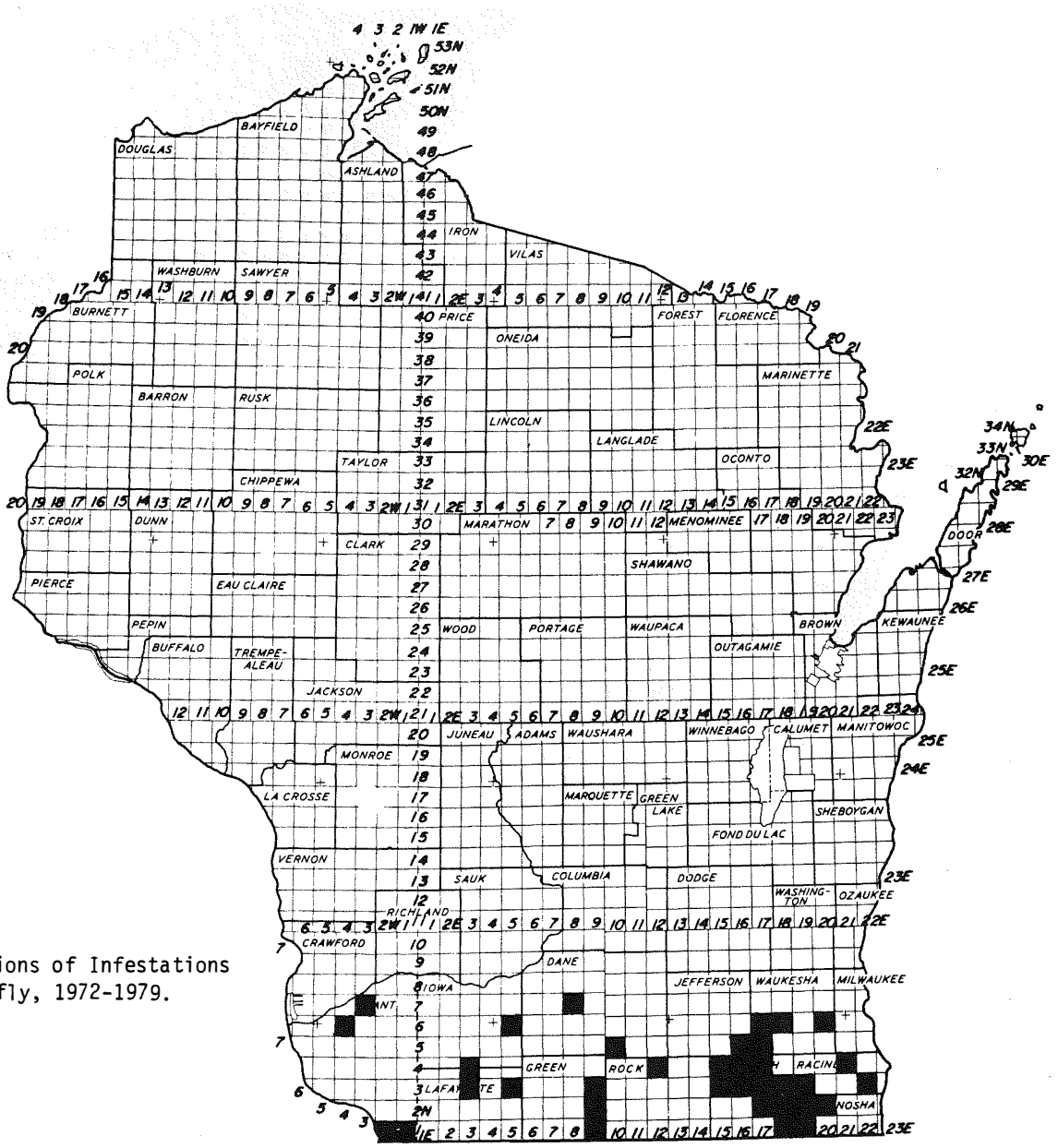

Figure 2. Township Locations of Infestations of the European Pine Sawfly, 1972-1979.

LEPIDOPTERA

Spruce Budworm - *Choristoneura fumiferana* (Clemens)

The gross area covered by the northeastern infestation remained stable (Figure 3) at about 140,000 acres but the area of heavy defoliation of balsam fir increased. White spruce plantings, 25-30 years old appear to support population buildup and stimulate localized heavy defoliation in surrounding natural stands. Since 1974, about 11,000 acres of natural balsam stands have suffered heavy mortality. Merchantable spruce and fir is being harvested at an increasing rate in and near the infestation.

About 1,300 acres of balsam fir were lightly to moderately defoliated in scattered locations in four northwestern counties. Light top killing and tree mortality occurred in these areas.

An egg survey of the eastern infestation revealed an average of 2.0 egg masses per 15 inch branch compared to 1.15 in 1978. Figure 4 shows the predicted defoliation for 1980.

Generally higher populations are expected in both infestations in 1980.

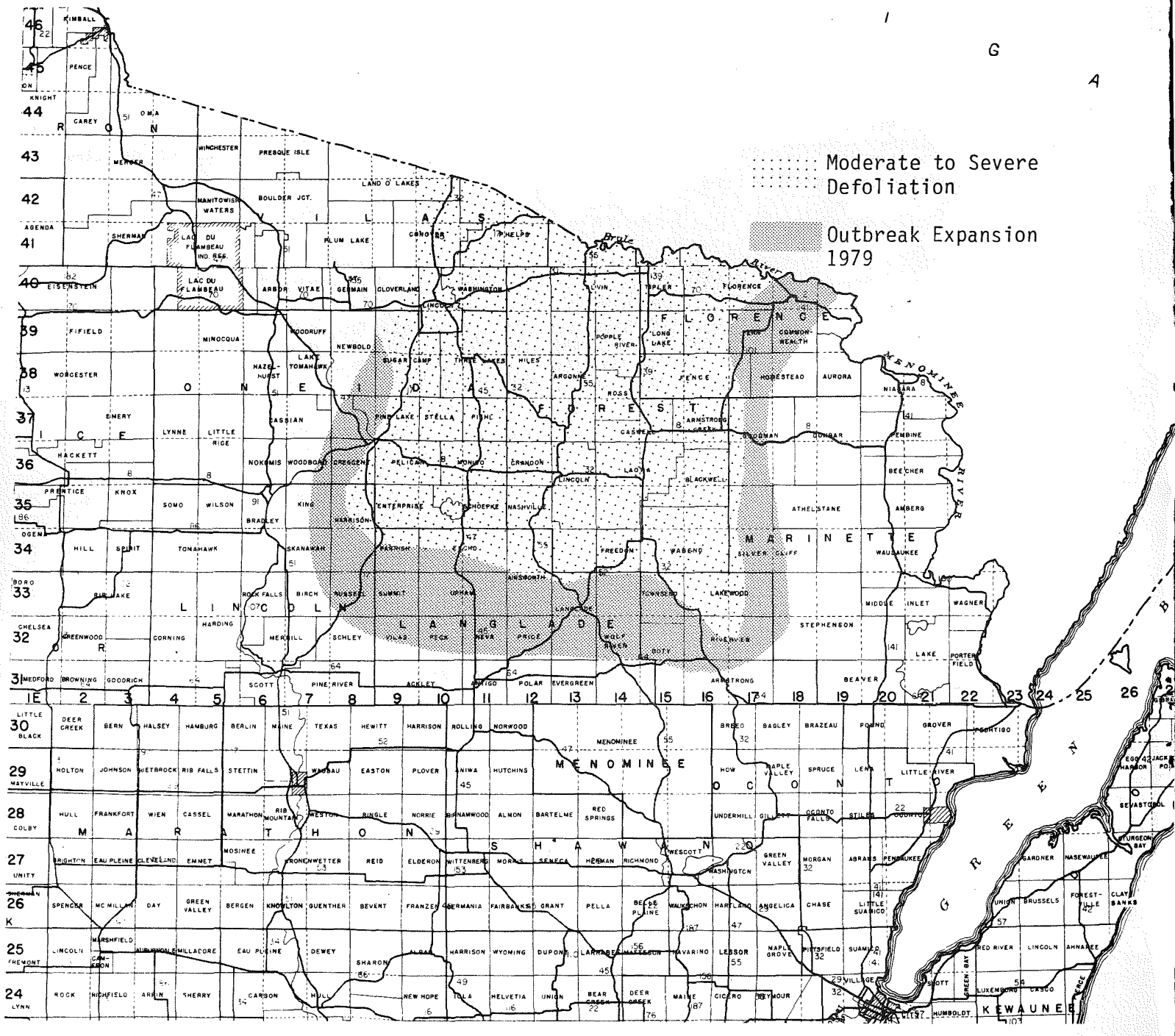

Figure 3. Spruce Budworm Infestation, 1979, Moderate to Severe Defoliation.

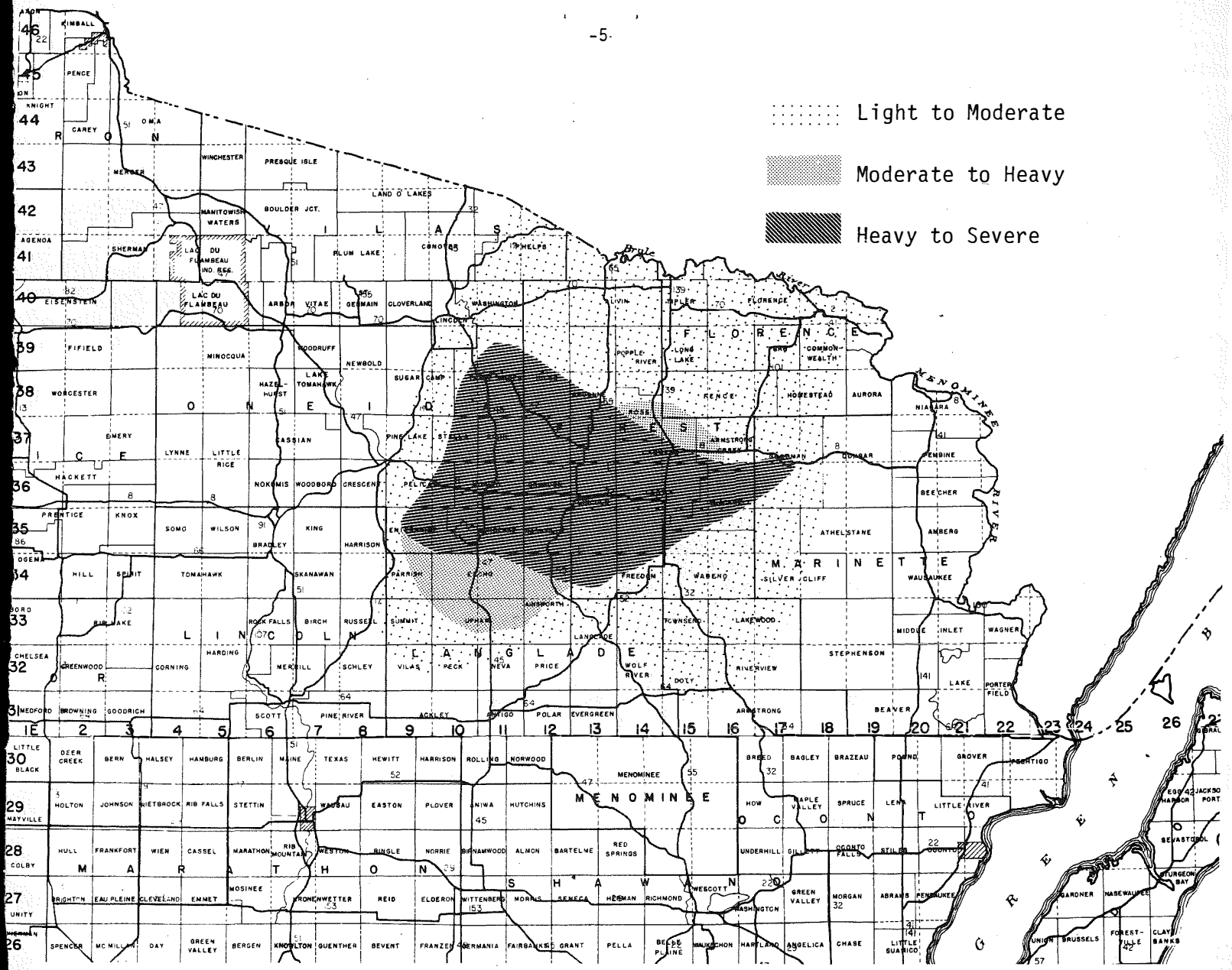

Figure 4. Predicted Location of Moderate to Severe Defoliation by the Spruce Budworm, 1980.

Jack Pine Budworm - *Choristoneura pinus* Freeman

The infestation in parts of three northwestern counties doubled in size. Heavy to severe defoliation occurred on 15,000 acres of jack pine; light to moderate defoliation occurred on 15,000 acres of jack and red pine. Heavy top mortality and light tree mortality is expected in the heavily defoliated areas. Some salvage harvests are being conducted. Continued eastward spread and an increased area of heavy defoliation is expected in 1980.

Pine Tussock Moth - *Dasychira pinicola* (Dyar)

About 600 acres of jack and red pine were lightly defoliated in southern Douglas County. An egg survey revealed scattered egg masses over most of the jack pine type in Douglas and Bayfield counties. Heavier defoliation is expected over a larger area in 1980.

Zimmerman Pine Moth - *Dioryctria zimmermani* (Grote)

The Zimmerman moth has attacked red pine tree terminal shoots for several successive years causing stagnation of height growth. The tree tops in 25-35 year old plantings have a "flattened," sheared appearance. The condition has been observed in Waushara, Waupaca, Marquette, Portage, Wood, Jackson, Monroe, LaCrosse and Trempealeau counties (Figure 5). A preliminary survey estimated that 25 percent of normal height growth was lost on 2,500 acres of red pine plantings in Jackson, Monroe and Trempealeau counties.

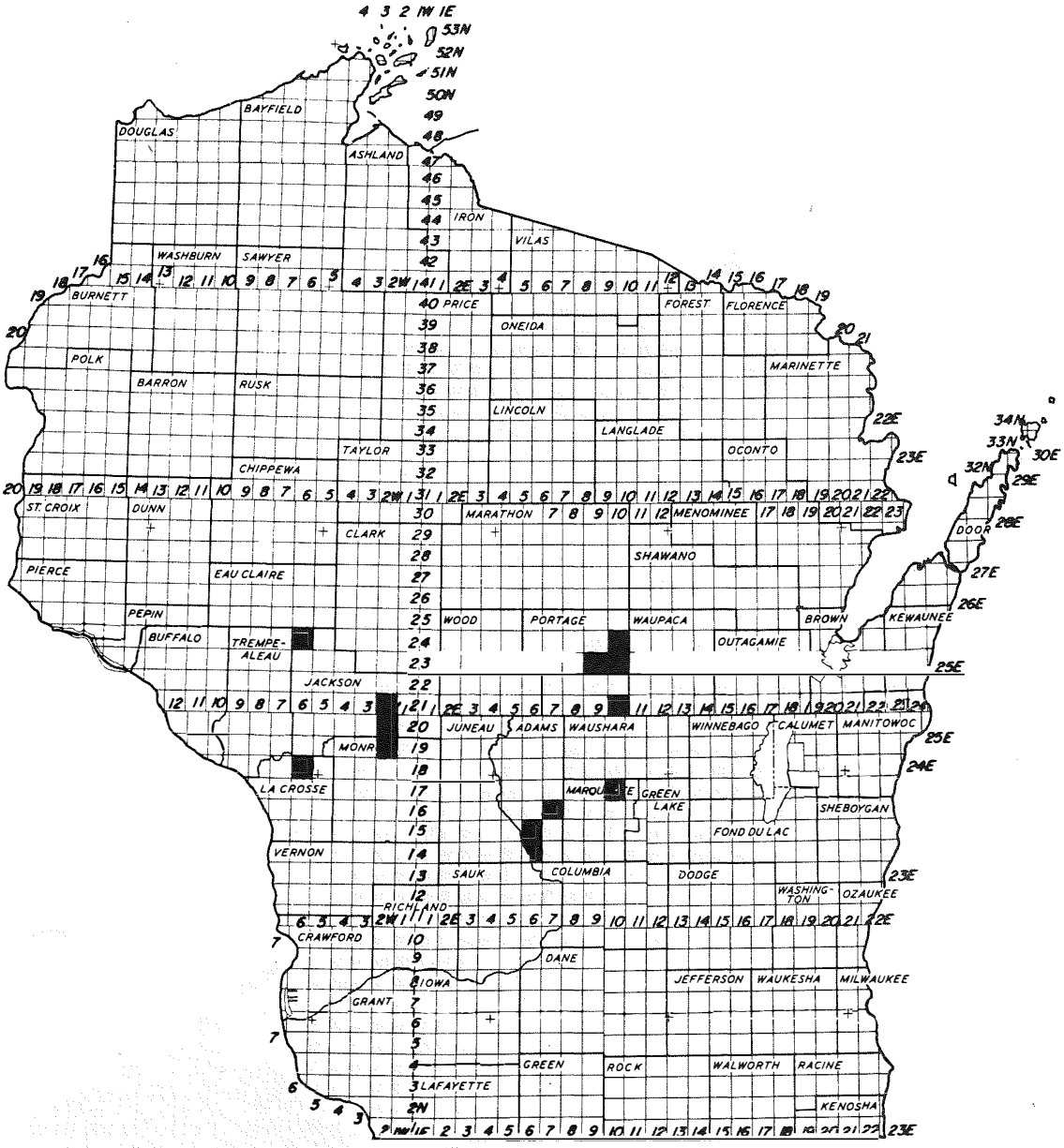

Figure 5. Zimmerman Pine Moth Moderate to Heavy Infestation, 1979.

Gypsy Moth - *Lymantria dispar* (L.)

The DNR Forest Pest Management Unit cooperated with Wisconsin Department of Agriculture and USDA, APHIS, PPQ in attempts to eradicate both the Oconomowoc and Appleton infestations. The materials, equipment and most of the cost of application and monitoring was provided by USDA. Part of the cost of application and much of the monitoring was shared by the state Department of Natural Resources and Department of Agriculture.

Oconomowoc - The Oconomowoc infestation covers about 400 acres just east of Oconomowoc in Waukesha County (Figure 6). In 1978, 643 adult males were trapped and 80 egg masses were found.

In late summer of 1978, releases were made of the egg parasite, *Ooencyrtus kuwanai*, totalling 328,000 (For details see Appendix A). Five egg masses were caged for observation and three more were found in the spring of 1979. Three larvae hatched from a small aberrant egg mass collected on April 15. None of the eggs hatched from 3 egg masses that were collected on May 7. Three caged egg masses were left to hatch in the field. Only one produced larvae (on May 15).

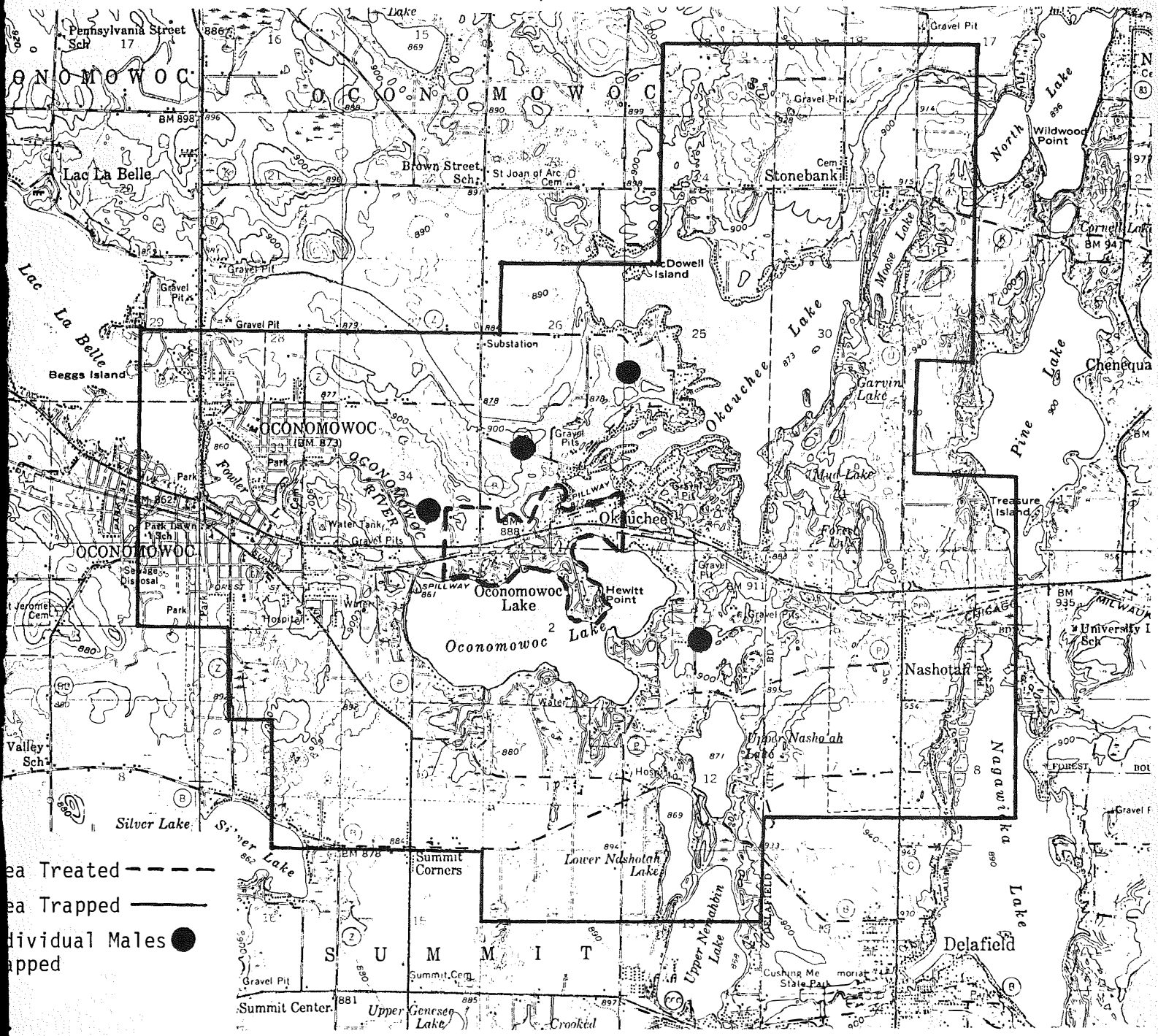

Figure 6. Area of Gypsy Moth Infestation at Oconomowoc, Wisconsin, 1979.

Most of the 80 egg masses found were located well off the ground to as high as 30 feet on tree trunks and limbs. Most were well hidden under loose bark on black willow, oak and shagbark hickory. The 1978-79 winter was one of the coldest and snowiest ever recorded. It is assumed that the extreme cold winter plus alternating warm and cold periods in April caused mortality of much of the overwintering population. The only egg mass known to have hatched was within a foot of the ground where it would have been well covered by snow for most of the winter.

Two aerial applications of 25,000,000 potency units per acre of Gypcheck, the gypsy moth virus, were applied in May. To monitor the effects of the virus application, several foliage searches for diseased larvae were conducted. No larvae were found.

On July 11, an aerial application of 20 grams per acre of racemic disparlure impregnated in plastic chips was made on the 400 acre infestation. To monitor the effectiveness of this application, (+) disparlure baited traps were placed in a grid at ¼ mile intervals covering about 25 square miles in and surrounding the treated area. Replicated releases of marked, sterile adult male gypsy moths were conducted on August 2. Three releases of 600 males each were made inside the treated area and three were made outside the treated area. One of the released males was trapped inside the treated area and 67 were trapped outside. No wild males were trapped inside the treated area; four were trapped outside on the fringe of treated area.

Appleton - The Appleton infestation was treated by placing three (+) disparlure baited traps per acre in the infestation. Seven males were trapped where 21 had been trapped in 1978.

Delimitation surveys will be conducted in both infestations in 1980.

The southern half of the state (Figure 7) was trapped in a detection survey with one racemic disparlure baited trap per 3 square miles. No male moths were caught in this survey nor in delimitation surveys at North Freedom, Devil's Lake and Madison where single males had been caught in previous years.

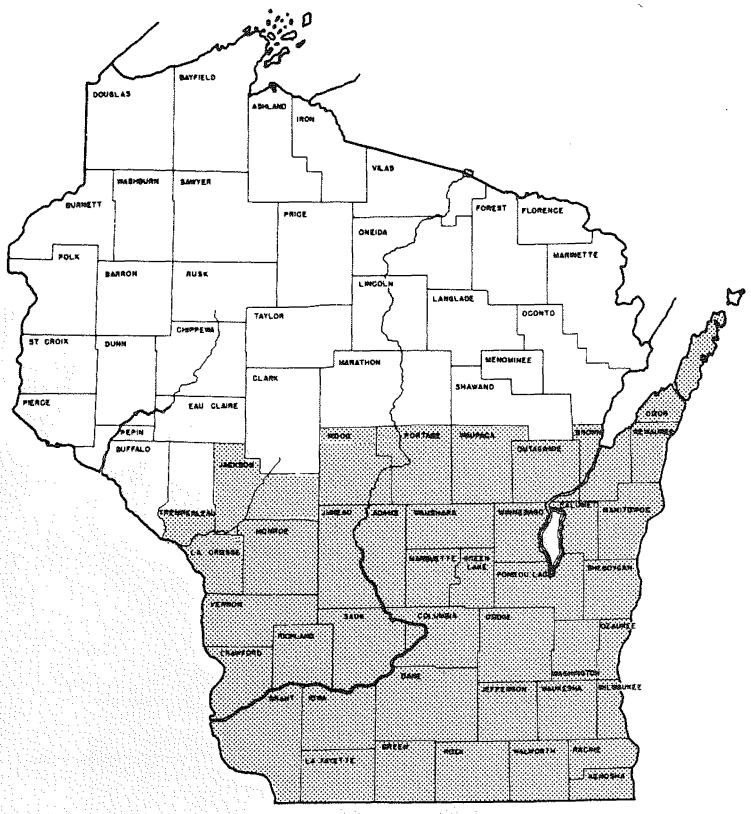

Figure 7. Gypsy Moth Detection Survey, Trapping Area, 1979.

Forest Tent Caterpillar - *Malacosoma disstria* Hubner

Populations increased and caused scattered light to heavy defoliation on 80,500 acres of oak and aspen in five northwestern counties. Two new pockets of defoliation were observed in Polk and Sawyer counties. Two local infestations east of Lake Nebagamon in Douglas County disappeared.

The areas of heavy defoliation are expected to increase in size in 1980.

ORTHOPTERA

Oak Grasshopper - *Dendrotettix quercus* Packard

Populations were heavier and more widespread than in 1978 in Clark, Eau Claire, Jackson, Monroe and Chippewa counties. Spots of heavy defoliation of black oak occurred in a three square mile area of Jackson County (S21, 22, 23, T20N, R4W). Several other species of grasshoppers were also more noticeable than in previous years, especially on light soils.

Walkingstick - *Diapheromera femorata* (Say)

Populations increased so that it was reported as generally present in Chippewa, Clark, Eau Claire and Jackson counties; a small infestation was reported in southern Dane County. About 200 acres of oak were severely defoliated in Clark (Sec. 6, T23N, R3W) and adjacent Jackson counties. Widespread defoliation in the west central counties is possible in 1981.

OTHER INSECTS

Insect Species	Host	Location	Remarks
COLEOPTERA			
Bronze Birch Borer *Agrilus anxius* Gory	White Birch	Northern two-thirds of state	Generally stable population; pockets of increased populations in several northeastern counties. The mortality is 2-5% in heavier areas.
Twolined Chestnut Borer *Agrilus bilineatus* (Weber)	Oaks	Entire state	General drastic decline in populations; a pocket of heavy mortality continued on Southern Unit-Kettle Moraine State Forest following heavy cankerworm defoliation.
Birch Bark Beetle *Dryocoetes betulae* Hopkins	White birch	Chippewa County T31N, R8W, T30N, R5W	Removed from small holes producing gummy exudate. May be important in birch dieback in Chippewa and neighboring counties.
Pales Weevil *Hylobius pales* (Herbst)	Scotch pine Christmas trees	Grant and Waushara counties	Occasional twig mortality due to adult feeding.
Pine Root Collar Weevil *Hylobius radicis*	Scotch Pine Christmas trees	Grant, Waushara, Waupaca, Shawano counties	Occasional tree mortality; a few pockets of heavy mortality.
Pine Root Tip Weavel *Hylobius rhizophagus* Millers			Heavey mortality in one jack pine plantation. Light mortality in other known infestations.
White Pine Weevil *Pissodes strobi* (Peck)	White Pine, Norway spruce	Northern three-fourths of state	General increase in populations. Heavy populations in white pine and Norway spruce plantations in Portage, Lincoln, Oneida and Jackson counties.
A Twig Gall Fly *Melanagromyza schineri* Giraud	Aspen	Jackson County	Infestation continues in natural reproduction growing on iron mine tailings.
HOMOPTERA			
Pine Spittlebug *Aphrophora parallela* (Say)	White pine, Scotch pine, Balsam fir	Shawano, Langlade, Oneida and Vilas counties	Heavy populations but no flagging in Christmas tree plantings. Two growers sprayed small acreage with malathion. Possible increasing populations next year.
White Pine Aphid *Cinara strobi* (Fitch)	White pine	Trempealeau County	Aphids in combination with drought and winter burn caused mortality of 30% of a small 8 year old plantation.
		Door, Marinette and Shawano counties	Heavy infestations on scattered trees.
An Aphid *Cinara* sp.	Red pine	Dane, Jefferson, Walworth, Waukesha counties	Large numbers of egg on needles observed in scattered locations in October.
Balsam Twig Aphid *Mindarus abietinus* (Koch)	Balsam fir Christmas trees	Monroe County	A 30 acre planting 4 to 15 years old has 60% of trees infected.
Pine Bark Aphid *Pineus strobi* (Hartig)	White pine	Waushara County	Very heavy populations on pole sized plantation trees.
A Pine Tortoise Scale *Toumeyella numismaticum* (P. & McD.)	Jack pine	Marinette and Jackson counties	Scattered individual trees have been heavily attacked.

HYMENOPTERA			
Introduced Pine Sawfly *Diprion similis* (Hartig)	White pine	Northern two-thirds of state	Significant increase in populations. Scattered areas of heavily defoliated individual large trees and open grown plantations. Evidence of parasitism common.
Birch Leaf Miner *Fenusa pusilla* (Lepeletier)	White Birch	Northern half of state	Stable or increasing populations. Especially heavy in Lincoln, Langlade, Oneida, Forest & Vilas counties where outbreaks have persisted for 3 to 5 years.
Redheaded Pine Sawfly *Neodiprion lecontei* (Fitch)	Red and jack pine	Oneida, Langlade and Menominee counties	Scattered plantations totalling about 250 acres had 10% of the trees heavily defoliated. Egg parasitism was heavy in Langlade County (Rauf et al. 1979).
Red Pine Sawfly *Neodiprion nanulus nanulus* Schedl	Red Pine	Columbia, Sauk, Iowa counties	Drastic decline in populations. No heavy defoliation. Scattered pockets of defoliated edge trees.
White Pine Sawfly *Neodiprion pinetum* (Norton)	White Pine	Southern one-fourth of state	Decline in populations. Very few reports of defoliation.
Larch Sawfly *Pristiphora erichsonii* (Hartig)	Tamarack	Entire state	Drastic increase in northern half of state; many stands heavily defoliated. Stable to slight decline in southern half of state; occasional stand with noticeable defoliation.
LEPIDOPTERA			
Fall Cankerworm *Alsophila pometaria* (Harris)	Oak, basswood, cherry	Jefferson, Walworth, Waukesha counties	Scattered pockets of heavy defoliation on the Southern Unit-Kettle Moraine State Forest is all that remains of an outbreak that started in 1975.
Walnut Caterpillar *Datana integerrima* Grote & Robinson	Black walnut	Southern one-third of state	Scattered individual large trees heavily to completely defoliated.
Maple Trumpet Skeletonizer *Epinotia aceriella* (Clemens)	Sugar maple	Langlade County	Thirty-five % defoliation on 200 acres.
Pine Candle Moth *Exoteleia nepheos* Freeman	Scotch pine Christmas trees	Grant County	Light infestation; one percent of trees had shoots attacked.
Saddled Prominent *Heterocampa guttivitta* (Walker)	Sugar maple, beech, white birch	Door County	Past outbreak has collapsed.
Eastern Tent Caterpillar *Malacosoma americanum* (-Fabricius)	Black cherry, choke cherry, wild plum	Entire state	Noticeable in north; drastic decline in south.
Pine Webworm *Tetralopha robustella* Zeller	Scotch pine Christmas trees	Grant County	Light population observed.

OTHER

Hail Damage	Aspen, white, jack and red pine	Jackson County	Severe hail injury on 20 acres of County owned forest land, which probably occurred in July of 1977, is probably the cause of deterioration (S2, T21N, R1W).
Blowdown	Tamarack	Columbia County	A windstorm in August knocked down a high percentage of tamarack on 400 acres. No volume estimates available (S9 & 10, T13N, R7E).
Salt Damage	Norway spruce windbreak	Lincoln County	Heavy salt damage destroyed 25% of the foliage and killed 1% of the trees. White pine also affected.

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MAJOR FOREST DISEASES
1979

WILTS AND DIEBACKS

Dutch Elm Disease - *Ceratocystis ulmi* (Buisman) Moreau

Dutch elm disease continues to be the major forest disease problem in Wisconsin. Approximately 50% of the elms in Wisconsin forests died between 1956-78. Utilization of diseased elm has been used to minimize economic loss from the disease. Approximately 500 million cubic feet of elm died from 1968-78, but almost 200 million cubic feet were salvaged. The disease was first reported in Wisconsin in 1958 and has been found in every county since 1975. Two species of elm bark beetles are active in dissemination of Dutch elm disease in Wisconsin. The smaller European elm bark beetle, *Scolytus multistriatus* (Marsham), is the principal vector in the southern half of the state (Figure 8). The native elm bark beetle, *Hylurgopinus rufipes* (Eichhoff), is the main vector in the northern counties (Figure 9).

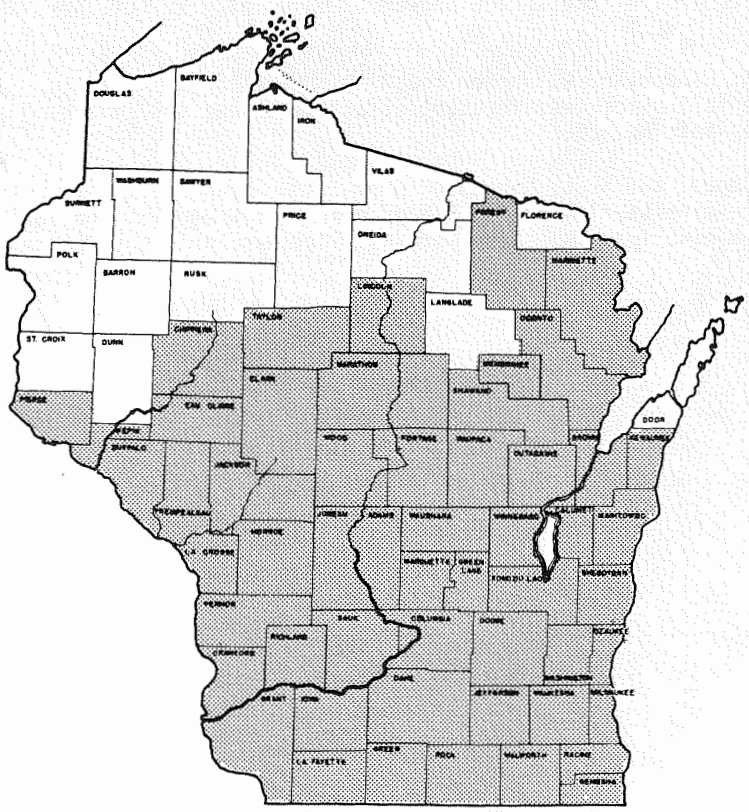

Figure 8. Known County Distribution of the Smaller European Elm Bark Beetle, *Scolytus multistriatus* (Marsham).

Figure 9. Known County Distribution of the Native Elm Bark Beetle, *Hylurgopinus rufipes* (Eichhoff).

Wisconsin municipalities spent $3.7 million in 1976 to control Dutch elm disease. In 1979 nineteen Wisconsin communities participated in a $568,476 Dutch elm disease control demonstration program that was sponsored by the U.S.D.A. Forest Service (Figure 10).

This program is utilizing all major known control measures including survey, injection, root graft control and sanitation (Table 1).

TABLE 1. WISCONSIN 1979 DUTCH ELM DISEASE DEMONSTRATION COMMUNITIES

Community	1979 Elm Inventory	1979 #	Losses %	1978 #	Losses %	Fungicide Treated Trees Preventative	Therapeutic	Total	1979 Municipal DED Budget	GFA Funds 1979 Initial Grant	Supplement	Total
Allouez	1,714	410	23.9	393	18.7	196	131	327	12,500	12,500	2,000	14,500
Bayside	4,510	126	2.8	90	2.0	55	200	255	10,300	8,000	3,000	11,000
Bloomer	1,612	167	10.4	30	1.8	688	37	725	15,000	14,000	10,200	24,200
Eau Claire	36,034	700	1.9	966	2.6	200	0	200	93,887	35,000	20,000	55,000
Elm Grove	4,676	254	5.4	274	5.5	591	0	591	7,300	9,000	--	9,000
Fox Point	4,320	570	13.2	280	6.1	941	280	1,221	15,000	8,000	--	8,000
Hudson	6,339	573	9.0	526	7.7	697	4	701	46,810	20,000	--	20,000
LaCrosse	20,815	5,704	27.4	2,444	10.5	--	--	--	--	7,000	--	7,000
Milwaukee	23,138	214	0.9	1,681	6.5	11	122	133	1,016,802	45,000	5,000	50,000
Monona	1,960	230	11.7	488	20.3	18	39	57	23,000	15,000	--	15,000
Neillsville	3,881	179	4.6	219	5.3	281	0	281	15,000	12,000	9,000	21,000
Onalaska	1,614	252	15.6	186	10.3	282	28	310	12,000	12,000	13,300	25,300
Rhinelander	1,675	237	14.1	341	16.9	150	0	150	16,300	13,000	9,000	22,000
River Hills	15,600	458	2.9	600	3.7	109	61	170	18,000	8,000	--	8,000
Shorewood	2,458	301	12.2	342	12.2	1,073	10	1,083	112,000	7,000	--	7,000
Tomah	1,744	722	41.4	750	30.1	0	79	79	3,000	14,000	2,000	16,000
Wauwatosa	16,253	518	3.2	747	4.4	0	70	70	282,536	10,000	59,000	69,000
Whitefish Bay	3,900	323	8.3	317	6.3	2,006	75	2,081	104,700	9,000	--	9,000
Wisconsin Rapids	8,192	1,216	14.8	1,058	11.4	427	39	466	90,150	32,000	55,000	87,000
TOTALS	160,435	13,154	8.2	11,732	6.8	7,725	1,175	8,900	1,894,285	290,500	187,500	478,000

Figure 10. Wisconsin Dutch Elm Disease Demonstration Communities, 1979.

Oak Wilt - *Ceratocystis fagacearum* (Bretz) Hunt

Oak wilt activity appears to have increased in central Wisconsin, especially in Columbia and Marquette counties; there was no change in the amount of apparent activity in counties to the east in the Lake Michigan District; and the disease appeared to be less active in the West Central District. There was no change in the county distribution of oak wilt in 1979 (Figure 11).

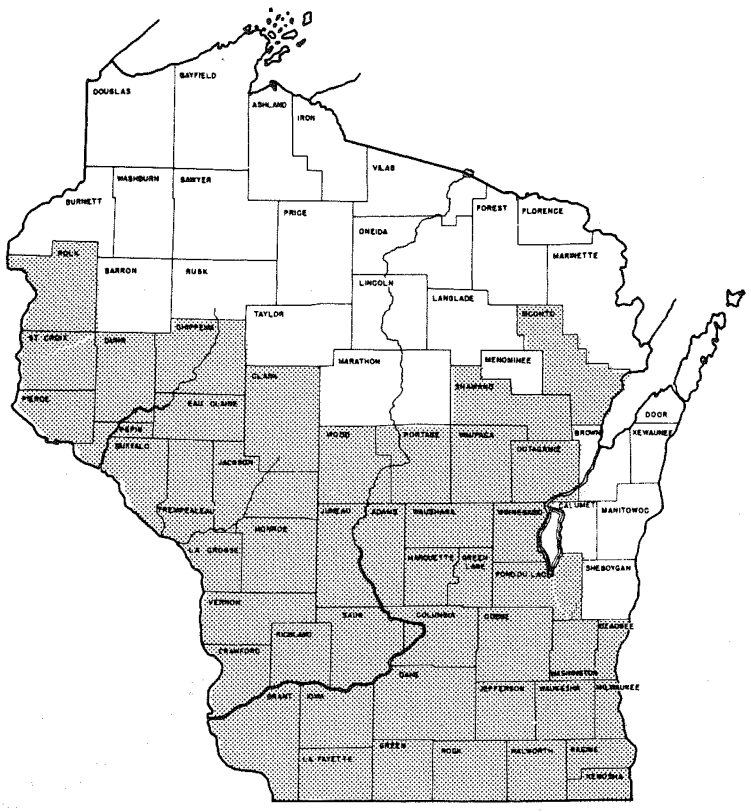

Figure 11. Known Distribution of Oak Wilt in Wisconsin - 1979.

Birch Dieback - Drought?

It is estimated that there are more than 100,000 cords of dead and dying white birch on hillsides in the unglaciated area of West Central Wisconsin. Scattered white birch mortality has also been reported on "high and dry" sites in Shawano, Oconto, Marinette and Florence counties. A smaller number of dead trees have been observed in Marathon and Langlade counties. The cause of birch mortality is unknown but may be related to the 1976-77 drought and repeated defoliated by birch leaf miner. Many trees are now invaded by the bronze birch borer and birch bark beetle.

STEM AND BRANCH DISEASES

Black Walnut Mortality - Winter Injury

In the spring of 1979 many open grown black walnut trees failed to produce new leaves. Many trees were killed and others exhibited branch dieback. Dead and dying walnut were reported from areas along the Wisconsin-Illinois line to as far north as Antigo where walnut shade trees were affected. Winter injury may have contributed to the dieback and mortality. The past winter was one of the coldest on record and the abundant black walnut seed production in the fall of 1978 may have depleted sugar reserves within the tree making it more susceptible to winter injury. There were numerous examples of winter injury to trees and shrubs such as privet, juniper, apple and white ash.

Black Walnut Basal Canker - Unknown

A basal canker has been observed on a few saw timber-size black walnut trees in Grant County, the cause is unknown. Pathologists at the University of Wisconsin are investigating if the basal canker is caused by a pathogen or environmental factors.

Butternut Canker - *Sirococcus clavigignenti-juglandacearum* Nair, Kostichka and Kuntz

Sirococcus clavigignenti-juglandacearum was isolated from a drying butternut tree at Pike Lake State Park in Washington County. This is the first record of the disease in eastern Wisconsin (Figure 12).

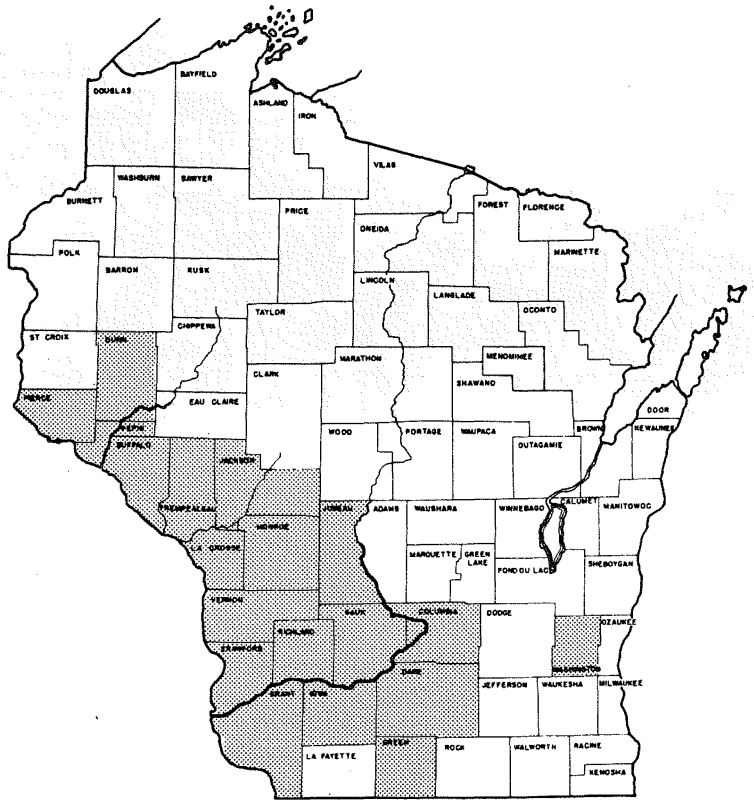

Figure 12. Know Distribution of Butternut Canker in Wisconsin, 1979.

Diplodia Canker - *Diplodia pinea*

In 1976, several red and jack pine plantations were infected with Diplodia canker and shoot blight in Adams, Bayfield, Douglas, Green, Richland and Wood counties. More than 5,000 acres of native and plantation red and jack pine were infected west of Millston (T20N, R3W) in Jackson County. Survey plots established in the area revealed that some trees infected in 1976 died in 1977. However, the fungus did not infect adjacent trees in 1977 or 1978. In 1977, new locations of Diplodia canker on red and jack pine were observed in Bayfield and Douglas counties where infection appeared to be associated with wounds caused by a hailstorm in 1976. *Diplodia pinea* has been collected in 20 counties in Wisconsin from 1976 to 1979 (Figure 13), but is most severe in pine plantations in Douglas, Jackson and Wood Counties.

Infected shoots of red pine seedlings have been observed at all three Wisconsin Forest tree nurseries. It appears that adjacent red pine windbreaks may be a major source of inoculum. In some red pine seedbeds at Griffith State Nursery, 14% of the seedlings were infected. However, losses were limited to less than 1% of the total red pine inventory.

On November 14, 1979, cones were collected from the red pine windbreaks surrounding the red pine seedling beds in block B at Wilson Nursery, Boscobel, Wisconsin. These seedling beds contained 1-0 red pine with dead terminal buds and browning secondary needles. The windbreak cones were examined at the laboratory and percent of cones with *Diplodia pinea* fruiting structures was calculated. (Table 2). The infected cones from the windbreaks can be a source of inoculum for future infection of the red pine seedlings.

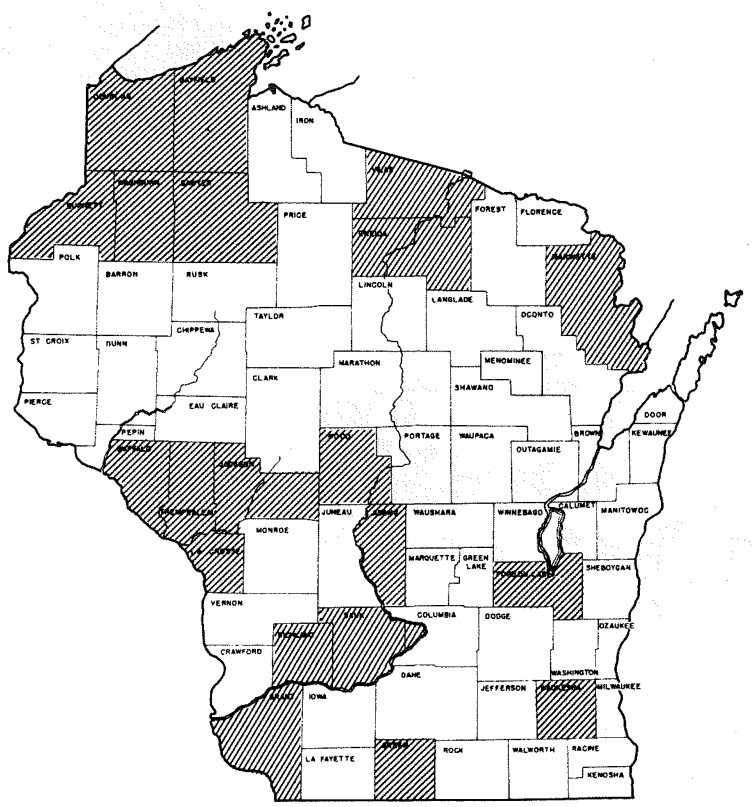

Figure 13. Known County Distribution of *Diplodia pinea*.

Table 2. Percent Red Pine Cones with Diplodia Fruiting Structures From Windbreaks Surrounding Block B at Wilson State Nursery, Boscobel, Wisconsin, November, 1979.

Windbreak Location	Cones Sampled (No.)	Cones with Diplodia (No.)	Cones with Diplodia (%)
North-South windbreak on west end of Block B	32	13	41
East-West windbreak on North end of Block B	46	16	35
North-South windbreak on East end of Block B	42	10	24
TOTAL	120	39	32

Research on the biology and control of *D. pinea* in plantations, windbreaks and nurseries in Wisconsin continued with a cooperative project between the North Central Forest Experiment Station, USDA-Forest Service and Wisconsin Department of Natural Resources. Preliminary results of fungicide spray trials at Griffith State Nursery indicate that three applications of benomyl at 3 lbs./100 gallons of water/acre, reduces infection of red pine nursery stock. Also removal of infected red pine within windbreaks in Green County, appeared to reduce new infection on adjacent trees. USDA-Forest Service, North Central Forest Experiment Station pathologists will be applying various fungicides to the red pine seedlings at Griffith and Wilson nurseries in the spring of 1980 to determine the most effective control.

Scleroderris Canker - *Scleroderris lagerbergii* Gremmen

There was no change in countywide distribution of Scleroderris canker in Wisconsin (Figure 14). However, one new location was found in Vilas County (SWNE, Sec. 2, T42N, R9E). Tree mortality continued in nine previously reported red pine plantations (four locations in Bayfield County and five locations in Vilas County) (Table 4). Several newly infected trees were observed in a Vilas County Plantation (NW¼, Sec. 24, T42N, R9E).

Serological testing of cultures in 1978 and 1979 from two locations in Bayfield County and two in Vilas County indicated the presence of the North American strain of Scleroderris. To date in the European strain of Scleroderris has not been found in Wisconsin. Surveys will be made annually in Bayfield and Vilas counties for any new location and records maintained on present locations.

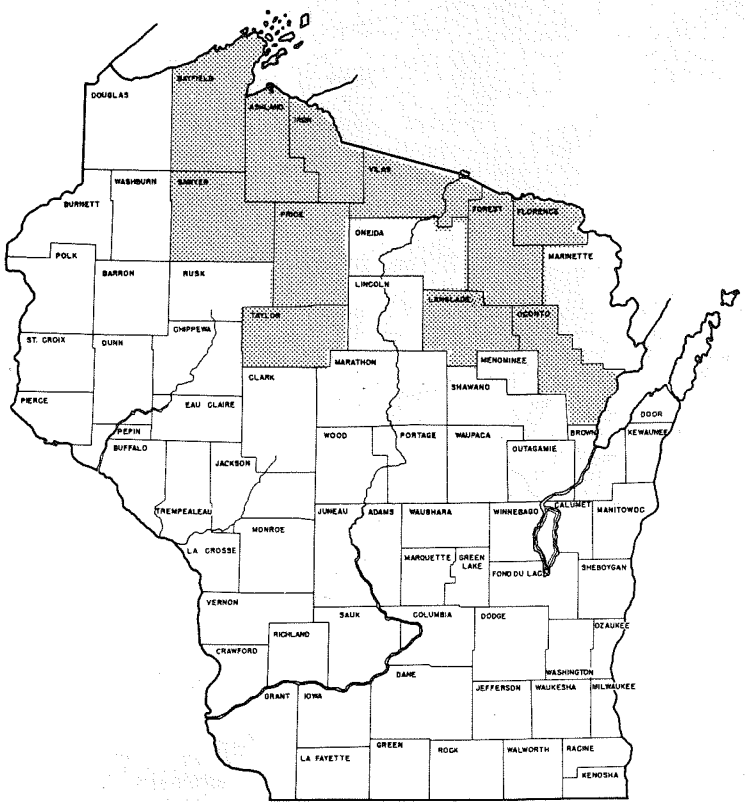

Figure 14. Known County Distribution of Scleroderris Canker in Wisconsin, 1979.

TABLE 4. Known Locations of Scleroderris Pine Canker in Wisconsin on State, County and Private Lands[1] - 1979.

	Location	County	Tree Species	Scleroderris Strain - (yr.)
1.	SW¼, Sec. 4, T47N, R8W	Bayfield	Red Pine	North American - (1978)
2.	E½, Sec. 35, T50N, R8W	Bayfield	Red Pine	Not Determined
3.	SWSE, Sec. 36, T50N, R6W	Bayfield	Red Pine	Not Determined
4.	NWNW, Sec. 4, T49N, R5W	Bayfield	Jack Pine	Not Determined
5.	NW¼, Sec. 24, T42N, R9E	Vilas	Red Pine	North American - (1979)
6.	NENW, Sec. 25, T42N, R9E	Vilas	Red Pine	North American - (1978)
7.	SESW, Sec. 32, T42N, R10E	Vilas	Red Pine	Not Determined
8.	SWNE, Sec. 31, T42N, R10E	Vilas	Red Pine	Not Determined
9.	NE¼, Sec. 8, T41N, R7E	Vilas	Red Pine	Not Determined
10.	SENE, Sec. 2, T42N, R9E,	Vilas	Red Pine	Not Determined

[1]Does not include Chequamegon or Nicolet National Forests.

Eastern Gall Rust - *Cronartium quercuum* (Berb.) Miyabe ex. Shirai

Department of Natural Resources forest managers working in the SW¼, Sec. 19, T32N, R18E of Marinette County noticed what appeared to be an unusually large number of jack pine seedlings infected with eastern gall rust. A quick survey indicated that 99% of the natural reproduction was infected with multiple galls that were often five feet above the ground. Records indicated that gall rust had always been present in the area but in the past several years environmental factors apparently favored increased infection. The disease appeared to be most severe in close proximity to northern pin oak stands growing in mixture with the jack pine.

The areas in Marinette County where the gall rust was so prevalent was formerly a jack pine plantation that was repeatedly defoliated by jack pine budworm. The defoliation caused top dieback and subsequent mortality. *Armillaria mellea* was frequently found in roots of dying trees. The plan was to harvest the jack pine in the plantation and lease the natural jack pine reproduction but because of the high incidence of eastern gall rust on the reporduction, the entire site will be cleared, bulldozed and replanted with red pine.

Red Pine Shoot Blight - *Sirococcus strobilinus* (Pruess)

Infection of current years shoots continued on previously infected sites on the Northern Highland State Forest and the Nicolet National Forest. Infected red pines are most commonly found in the Northern Highland State Forest in Boulder Junction, Starr Lake and Sayner areas, others are in the Nicolet National Forest along forest road 2183 and 3865 east of Three Lakes and 2178 north of Hwy. 70 east of Eagle River. One new location was recorded in 1979 (SWNE, Sec. 2, T42N, R9E, Vilas County).

There has been no change in the county distribution of red pine shoot blight since 1974 (Figure 15). However, there has been an increased number of infected current year's shoots of understory trees with plots on the Northern Highland State Forest (1978 - 50-75% infected, 1979 - 60-85% infected).

This is a cyclical disease of periodic importance. Dry periods during May and June reduce incidence and wet periods increase incidence of this disease. The disease has only been recorded north of 45°N. Lat. Silvicultural control measures are being tried to reduce disease incidence. The Northern Highland State Forest has 12 overstory removal plots and the Nicolet National Forest has 14. Infected overstory trees were removed to protect understory trees. These are research tests covering about 50 acres. Control has been excellent. It appears that silvicultural controls can reduce the impact of this disease to a manageable level and that the fungicide Chlorothalonil can be used in nurseries to prevent infection of red pine nursery stock.

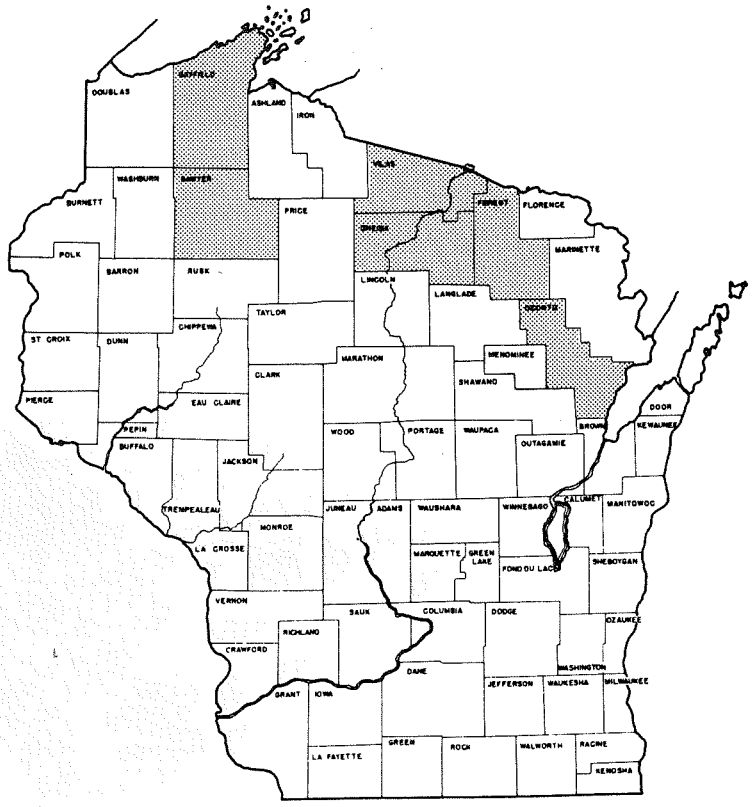

Figure 15. Known County Distribution of Red Pine Shoot Blight, 1979.

ROOT ROTS

Nursery Diseases

Because of major losses of conifer seedlings in Wisconsin's best tree nurseries from 1976-78. A Nursery Disease Control Swat Team was organized in 1979 to determine the cause of stunting and mortality of conifers in Wisconsin Forest Tree Nurseries. The team was comprised of pathologists from the North Central Forest Experiment Station, State and Private Forestry, U.S. Forest Service, DNR, University of Wisconsin, and DNR nursery managers. A work plan was developed in March. Team members went to work in May, met as a group in June, and reported on their findings in October (Appendix B). Plans are to continue with the highly sucessful Swat Team approach in 1980.

FOLIAGE DISEASES

European Larch Needlecast - Unidentified

An unidentified fungus was collected from defoliated European larch at the Coulee Experimental Forest near LaCrosse.

Spruce Needle Cast - *Rhizosphaera kalkhoffii* Bub.

There were frequent reports of needle cast on blue spruce Christmas trees in west central Wisconsin. Rhizosphaera needle cast reduced the growth and harvest of 1000-2000 blue spruce Christmas trees in a Clark County plantation (S½, NE¼, Sec. 18, T23N, R2W). A count of 14 groups of 10 trees each, found 106 trees (75%) with needle loss and necrosis. Damage was confined to older needles when the current year's foilage was sprayed with a fungicide and it was not known if the fungicide protected the needles or if symptoms were not yet visible when the trees were examined on August 22, 1979.

Aspen Bronzing - Unknown

Aspen bronzing continued to be observed at 20-30 locations throughout the state but may be widely distributed than surveys indicate (Table 3). Leaves on individual large-tooth and trembling aspen will turn yellow in July or August and within 10-20 days become golden bronze to brown. The remaining leaves on the rest of the tree remain green and healthy. When normal fall coloration occurs leaves on affected branches are a dark brown with yellow petioles, while unaffected leaves are yellow. Examination the following year reveals that branches bearing bronze leaves are dead. The number of bronze leaf bearing branches increases each year until the tree dies. No insects or fungi are associated or isolated from the bronzed branches or leaves. Studies are underway at the University of Wisconsin to determine if the leaf bronzing is caused by a virus. Other scientists are investigating the possibility of bronzing being caused by bacteria.

Table 3. Known Locations of Bronzing of Large Tooth Aspen in Wisconsin - 1979

County	Location	Description
Bayfield	Hwy 2	0.7 miles east of National Forest road 419 on Hwy 2, South Side of road.
Douglas	Gordon	2.75 miles west of Hwy 53 on Y.
Fond du Lac	Kettle Moraine	South of Hwy 67 - 3/8 mile west of the intersection of Hwy 67 and G, south.
Langlade	Lady Lake	West side of Hwy 45, ¼ mile north of Lady Lake
Langlade	Wolf River	.4 mile south of Wolf River on County A, west side of road.
Marinette	Wausaukee	North edge of scenic overlook parking lot on Hwy 141, about 6 miles north of Wausaukee, west of road.
Oneida	Monico	Hwy 45 to 8 (left) to old Hwy 8 (left) to area cut in 1972 - on "consolidated land."
Price	Twin Lakes	Twin Lakes Campground in Chequamegon on National Forest at campsite #10.
Sauk	Devil's Lake	Six locations
Vilas	Trout Lake	Hwy 51 to M (right), about 1 mile past N at Perch Lane. Just past Perch Lane on both sides of Hwy M.
Vilas	Woodruff	East of Hwy 51, 1.4 miles north of 70 East.
Waushara	Coloma	East of Hwy 51, at mile marker 160.5

Aspen Leaf Spot - *Ciborina bifrons* (Whetz.)

Previous reports of this disease have been from northwestern Wisconsin. This is the first major defoliation in north central Wisconsin.

A total of 8,000 acres of trembling aspen were infected in Langlade, Lincoln and Marathon counties (Figure 16). In northern Lincoln and western Langlade counties 75% of the foliage was infected. Ground and aerial surveys of the area are planned for 1980.

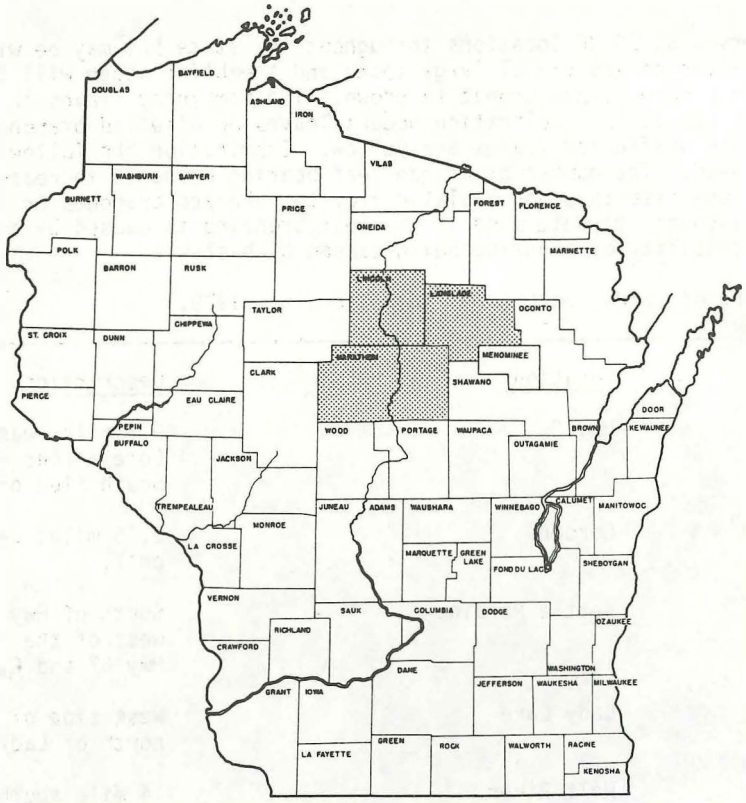

Figure 16. Known County Distribution of *Ciborinia bifrons* on Trembling Aspen, 1979.

White Pine Needle Blight - Atmospheric Gases

White pine needles are sensitive indicators of the presence of relatively low concentrations of sulfur dioxide and ozone in the atmosphere. Either of these gases causes a characteristic reddish-brown discoloration of the needle tips which is known as tip-burn or white pine needle blight.

OTHER

Ash Leaf Fall

Premature ash leaf drop from unknown causes occurred over much of the southern part of the state. Signs of earlier activity by sucking insects and mites were present at the time. Margins of leaves were usually curled downward. Leaves were generally green and free of signs of fungal infections.

Air Pollution

The DNR Forest Pathologist was requested to investigate pollution damage to vegetation at Reedsburg, Wisconsin. The area was examined on July 19, 1979 and injury resembling that caused by sulfur dioxide was observed on white oak, blue spruce, white pine and Scotch pine. The source of the pollutant was unknown but damage was most severe in the southeastern part of the city. There was concern that additional damage occurred in August but a survey on August 30 revealed there was no new injury but only intensification of symptoms from the previous fumigation.

Air pollution injury to trees growing in the John Alexander School Forest, Port Edwards, Wisconsin (Sec. 34, T22N, R5E) was reported on September 11, 1979. An examination of the area the next day revealed necrosis of white pine and aspen foliage. Northern pin oak was not affected. This is the second time injury of this type has been reported. The first report was in 1971 when tipburn and necrosis was observed on jack pine, white pine and white oak. The source of the pollution is unknown but may be associated with the adjacent chlorine-caustic soda plant at Port Edwards, Wisconsin.

Winter Injury

Short-needle varieties of Scotch pine Christmas trees continue to be susceptible to winter injury. This is the second year in succession that numerous Christmas trees were unmarketable because of winter injury.

A sampling of Christmas tree producers in Minnesota and Wisconsin by the North Central Forest Experimental Station in 1979 revealed that $1,491,625 worth of trees were lost from 1976-79 (Table 5). Christmas producers are planning to plant less susceptible species of conifer such as balsam fir, black hills spruce, red pine and selected resistant varieties of Scotch pine.

TABLE 5. Christmas Tree Winter Injury Losses, 1976-79.

State	Number Growers Reporting	Number Trees Lost	Dollar Value
Minn.	32	781,000	1,530,000
Wisc.	51	455,745	1,491,625
TOTAL	83	1,236,745	$3,021,625

Spruce Chlorosis - Unknown

Yellowing of the current year's foliage was observed on 5 to 10-year old white spruce in NESE, Sec. 19, T13N, R8E of Columbia County in September. The needles were green when previously observed in August. Yellowing was more severe in the upper than lower crown. On some twigs foliage was yellow on the upper side and green on the lower side. Foliage low to the ground and covered with grass was green. It is not known if the grass protected the foliage from sunlight, air pollution or both. The trees were growing on a Houghton muck soil with an approximate pH of 8 which is high for white spruce.

APPENDIX A

BIOLOGICAL CONTROL PROGRAM

by
David J. Hall[1]/

Monitoring parasite populations

Ooencyrtus kuvanae (Howard) The release of this gypsy moth egg parasite was reported in the 1978 annual report. During the fall of 1978 field collected eggs were taken into the lab and *O. kuvanae* emerged from them. Overwintering mortality of gypsy moth eggs was extremely high. Only one egg mass was known to successfully hatch in the field and that was in a cage. No viable eggs were found with which to check the overwintering success of the adult parasites. Because of the extremely low numbers of the host, this parasite is presumed to be similarly low or nonexistent in the area.

Lophyroplectus oblongopunctatus (Hartig) Collection and rearing of thousands of European Pine Sawfly larvae in 1978 by University of Wisconsin personnel (See Kraemer et al 1979) yielded 1 specimen in the spring of 1979. This species, previously named *L. luteator* Thunberg, was released in Walworth County in 1977.

Other collections. A total of about 3000 larvae were collected and reared in search of various parasites with no notable recoveries.

European Pine Sawfly Virus Project. The sawfly was discovered in Wisconsin in 1972. Populations in the southeastern counties have been monitored since 1972. Some populations have existed at outbreak levels for five consecutive years in red pine plantations. The nuclear polyhedrosis virus has not been observed in any of these populations.

Researchers of the Northeast Forest Experiment Station, USDA Forest Service, made small-plot applications of the virus in 1979 on the Kettle Moraine State Forest-Southern Unit in Waukesha County. If the virus persists here it will be artifically relocated to many of the known infestations in 1980.

In response to a request for sawfly larvae, DNR and UW-Madison, Department of Entomology personnel field-collected about 80,000 larvae in one day and shipped them to North Eastern Forest Experiment Station laboratory at Hamden, Connecticut. They were needed for production of more virus.

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1979. Establishment of *Lophyroplectus Luteator*, a larval parasitiod of the European pine sawfly *Neodiprion sertifer*, in Wisconsin Univ. of Wis. For. Res. Note No. 225.

[1]/Forest Entomologist, Department of Natural Resources, Madison, WI.

APPENDIX B

SWAT TEAM WORK PLAN AND PROGRESS REPORTS

NURSERY DISEASE CONTROL PRELIMINARY WORK PLAN, WISCONSIN, 1979.

Swat Team Action and Responsibilities

I. Trouble shoot at Griffith, Hayward and Wilson nurseries (Prey and Zarnstorff[1]/)

   A. Study and evaluate conifer damping-off and root rot. Collect seedling and soil samples when appropriate.
   B. Conduct laboratory work, such as isolating from seedlings and conducting soil dilutions to determine what organisms are present.

II. Evaluate Nursery Soil Fumigation (Prey, Zarnstorff and LaMadeleine[2]/)

   A. Collect soil from nonfumigated beds and beds fumigated with Methyl Bromide or Mylone at Griffith, Hayward and Wilson nurseries. (Prey and Zarnstorff)
   B. Check soil samples for the presence of organisms including *Fusarium* spp. and *Rhizoctonia solani*. (Prey and Zarnstorff)
   C. Collect seedlings from nonfumigated beds, beds fumigated with Methyl Bromide and beds fumigated with Mylone. Isolate and determine organisms present in each treatment. (LaMadeleine)

III. Survey Seed for Pathogens (Borkenhagen[3]/, LaMadeleine, Belcher[4]/)

IV. Continue to investigate the pathogenicity and the epidemiology of *Fusarium oxysporum* and disease problems of pine seedlings. (Berbee and Simmons[5]/)

V. Investigate the cause of "Bird peck". (Berbee, Prey and Zarnstorff)

   A. Collect seedlings and soil samples where "bird peck" damage occurs, isolate from seedlings, and make soil dilutions. (Berbee, Prey and Zarnstorff)
   B. Conduct experiments with soil from "bird peck" areas to determine the cause. (Berbee)
   C. Assist Berbee in collection of soil samples from "bird peck" areas. (Prey and Zarnstorff)

VI. Investigate the cause and epidemiology of white pine root rot in state nurseries. (Berbee and Simmons)

VII. Control of white pine root rot in state nurseries. (Nicholls and Palmer[6]/)

VIII. Investigate the cause of stunting of conifers in State and Federal nurseries. (Nicholls, Palmer and Soil Toxicologist)

IX. Establish fungicide control plots for Diploia shoot blight of red pine at Griffith Nursery. (Nicholls and Palmer)

X. Establish and maintain weather stations for all of the above disease control studies. (Borkenhagen, (Camp, Wojahn[7]/), and Nicholls)

XI. Study interactions between pine seedlings, root rot fungi, mycorrhizae and soil nutrients in nursery soil. (Nicholls and E. Stewart[8]/)

XII. Summarize and report results of disease control progress in 1979. (Prey and Zarnstorff)

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2/Plant pathologist, USDA Forest Service, State and Private Forestry, St. Paul, MN.
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4/Director, Eastern Tree Seed Laboratory, USDA Forest Service, State and Private Forestry, Macon, GA
5/Professor of plant pathology and graduate student, University of Wisconsin.
6/Principal and assistant plant pathologist, USDA Forest Service, North Central Forest Experiment Station St. Paul, MN.
7/Superintendents at Wilson and Griffith State Nurseries, Wisconsin Department of Natural Resources.
8/Associate professor of mycology at the University of Minnesota.

SOIL SURVEY FOR THE PRESENCE OF *FUSARIUM* SPP. AND THE EFFECTS OF SOIL FUMIGATION ON THE POPULATION OF *FUSARIUM*

by
Jane Zarnstorff and Allen Prey[1]/

Introduction

Since 1975, seedling mortality, stunting, cutworms, and root rot have been the cause of major seedling losses in Wisconsin forest tree nurseries. Approximately 800,000 seedlings were lost at Wilson Nursery in 1976 (2), and an estimated yearly loss of over 1,000,000 seedlings worth approximately $30,000, has been occurring at Hayward nursery since 1976. (1)

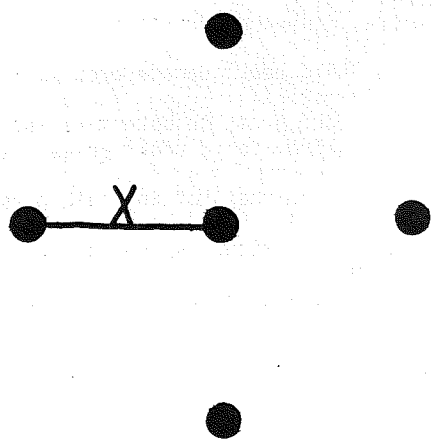
Nursery managers often have to increase their seeding rates because of an anticipated loss of 25% of the seedlings from time of planting to full development as 1-0 seedlings. Past methods of controlling the stunting, root rot, and mortality with fungicidal sprays and soil fumigation with Mylone have been unsuccessful.

In past surveys, *Fusarium* spp. were frequently isolated from conifer seedlings, (7) and University of Wisconsin pathologists are currently investigating *Fusarium's* role as a pathogen. The Department of Natural Resources conducted a soil survey at all three Wisconsin state nurseries to determine the following:

A. Is *Fusarium* present in nonfumigated soil from areas with different crops?
B. What effects do the soil fumigants Mylone and Methyl bromide have on the frequency of *Fusarium* in the soil?

Materials and Methods:

Soil samples were collected from each nursery in May, July, August, and October, 1979. Each sample was a composite of five, six inch soil cores taken in a cross pattern, with each outer core one foot from the center core (Fig. 1).



X = 1 foot

Figure 1. Sampling layout for one composite soil sample.

At least six sections were sampled at each nursery, and three samples were collected per section (section = .6 acre). Samples were collected with a sterile soil agar, placed into sterile plastic bags and stored at 4°C. In May, 1979, samples were collected from red pine seedbeds fumigated with Methyl bromide and Mylone, and from nonfumigated sections where rye was growing as a winter cover crop. In July, sections being prepared for fumigation in the fall with cover crops of sorghum-Sudan grass and buckwheat were sampled. In August and October, these same section were sampled to determine the *Fusarium* population levels before and after fumigation.

Each sample was diluted with a .3% water agar solution to 1:100, 1:500, and 1:1000. One milliliter of each dilution was spread onto selected media and kept at 22°C. The three selective media chosen for *Fusarium* were Komada (3), Nash and Snyder (4), and PCNB (modified) (5). The fungi Pythium and Phytopthora were suspected to be present in the soil, therefore the selective media VYS-PCNB (6) was used.

[1]/Laboratory Technician and Forest Pathologist, Wisconsin Department of Natural Resources, Madison, WI.

After six days, the fungal colonies were examined microscopically and the number of *Fusarium* colonies tallied. Based on the dry weight of soil from each sample, in three milliliters of 1:10 dilution, the number of colonies (propagules) per gram of soil was calculated.

Results and Discussion:

Samples collected in May, 1979, from soil fumigated with Methyl bromide and Mylone, had lower numbers of *Fusarium* propagules per gram of soil than samples collected from nonfumigated soil (Table 1). Methyl bromide (MC-33) was more efficient than Mylone in reducing the *Fusarium* propagules. *Fusarium* propagules were also present in nonfumigated soil where sorghum-sudan grass, buckwheat, rye, and 2-0 white pine were growing (Table 2).

Samples collected from sections before and after fumigation were analyzed and results showed that both Mylone and Methyl bromide reduce the propagules of *Fusarium* in the soil, but Methly bromide is more effective in reducing the frequency of *Fusarium* (Table 3).

No *Pythium* or *Phytopthora* species were isolated from soil samples.

TABLE 1. Propagules of *Fusarium* spp. per Gram of Soil at Three Wisconsin Tree Nurseries, May, 1979.

Nursery	Treatment[a] Fumigant	Rate Lb/A.	Propagules of *Fusarium* spp. per Gram of Soil
Griffith	Mylone	400	917
	Methyl bromide (MC-33)	300	0
	None		1696
Hayward	Mylone	400	1400
	None		8200
Wilson	Mylone	400	435
	Methyl bromide (MC-33)	300	0
	None		7629

[a]Mylone and Methyl bromide were applied in August, 1978.

TABLE 2. Propagules of *Fusarium* spp. per Gram of Soil in Nonfumigated Soil at Three Wisconsin Tree Nurseries, 1979

Nursery	Crop	Propagules of *Fusarium* per Gram of Soil
Griffith	White pine	1696
	Sorghum Sudangrass	2722
Haward	Rye	8200
	Buckwheat	3531
Wilson	Rye	7629
	Sorghum Sudangrass	3377

TABLE 3. Propagules of *Fusarium* spp. per Gram of Soil Before and After Fumigation at Three Wisconsin Tree Nurseries, 1979.

Nursery	Treatment[a] Fumigant	Rate Lb/A	Propagules of *Fusarium* spp. Per Gram of Soil Before Fumigation[b]		Propagules After Fumigation[c]
Griffith	Mylone	400	2722	E-32	1347
	Methyl bromide (MC-2)	500	2545	G-78	0
	Methyl bromide (MC-2)	500	1837	E-35	0
Hayward	Mylone	500	2260	B-5	261
	Mylone	400	3531	B-6	540
Wilson	Mylone	400	3346	C-47	1322
	Methyl bromide	300	5306	B-38	24

[a]Mylone and Methyl bromide were applied in August, 1979.
[b]Samples collected July and August, 1979.
[c]Samples collected October, 1979.

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SURVEY FOR THE PRESENCE OF NEMATODES IN SOIL AND ROOT SAMPLES FROM HAYWARD, GRIFFITH, AND WILSON FOREST TREE NURSERIES, 1979

by
Robert Martin and Jane Zarnstorff[1]/

Introduction

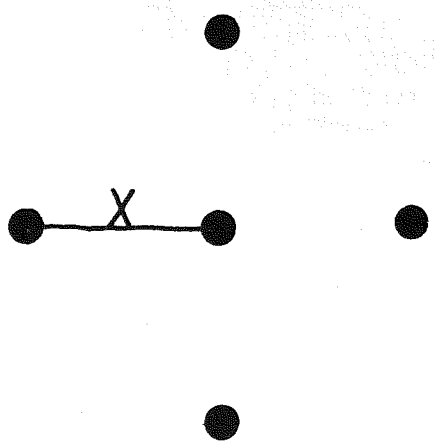
Since 1975 there has been an unidentified root rot of white pine seedlings at the Wilson and Griffith state forest tree nurseries. An estimated 800,000 white pine seedlings were lost at the Wilson Nursery in 1976 (1) with an additional 210,000 white pine seedlings lost at the Griffith Nursery since 1976 (4).

Pathologists at the University of Wisconsin-Madison are currently investigating the pathogenicity of *Fusarium* spp. in relation to white pine root rot and seedling mortality. The Wisconsin Department of Natural Resources has conducted soil surveys to determine the population of *Fusarium* spp. and nematodes in the state forest nurseries. This report will discuss the results of the nematode surveys and the details of some ongoing experiments to resolve the role of nematodes in the white pine root rot problem in the state forest nurseries.

Materials and Methods

Samples were collected to determine; 1. Nematode populations in areas with the white pine root rot problem and areas with healthy white pine; 2. The effect the soil fumigants Mylone and Methyl bromide have on nematode populations in the soil; and 3. The effect cover crops have on nematode populations.

Soil samples were collected from Griffith Nursery in August, September and October, 1979, and from Wilson and Hayward nurseries in October, 1979. Each sample consisted of five, six inch soil cores taken in a cross patern with the outer cores taken one foot from the central core (Fig. 1). Three samples were collected per section (0.6 acres).



X = 1 foot

Fig. 1. Soil Sampling Pattern.

Nematodes were collected from the soil samples by the decanting and sieving method Cobb(2). Nematodes from root samples were collected by placing roots in water in flaskes on a shaker according to the method of Edmunds and Mai (3). Samples were left on the shaker for three days, after which the number of nematodes per gram of fresh root tissue was determined.

Nematode and fungicide test plots were set up at Griffith Nursery in September 1979, in a bed where the white pine root rot problem was severe. Three fungicides: Benomyl, Rdomil and Bayleton, effective against Fusarium, Phycomycetes and a broad spectrum fungicide respectively; and three systemic insecticides, Temik, Furadan and Vydate, effective against endoparasitic nematodes were used. Treatments consisted of each chemical used alone and each nematicide used in combination with each fungicide. Each treatment was replicated five times and each treatment was surrounded by untreated plots to avoid border effects.

Results and Discussions

The nematode population in roots of healthy white pine seedlings was considerably less than the population in the roots of diseased seedlings (Table 2). However, the results at this stage are preliminary and do not show which came first, the root rot or the nematodes.

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Both Methyl bromide formulations, MC-2 and MC-33, at the rates used, reduced the nematode populations in the soil to virtually zero (Table 3). However, there were considerable numbers of nematodes in the soil after fumigation with Mylone though the populations were less than nonfumigated areas (Table 3).

The investigations into the role, if any, nematodes play in the root rot of white pine seedlings at Griffith and Wilson nurseries are preliminary. Fungicide and nematicide trials have been set up at Griffith Nursery to help us determine what is causing the root rot problem and determine a chemical method to control the disease. Five replicates of each treatment were set up in 1979 and three of the replicates will be treated again in 1980 to determine if more than one application is necessary to control this root rot problem.

Evidence suggests that nematodes may prefer sorghum-sudangrass over buckwheat as a host (Table 3). In 1980, nematode populations will be surveyed before and after the cover crops are planted to further evaluate the possibility of cover crop selection as a cultural method to control nematodes in the state forest nurseries.

TABLE 1. Comparison of Nematode Populations in Soil from Diseased and Healthy Whie Pine Seedlings at the Wilson and Griffith State Forest Nurseries

Nursery	Diseased/Healthy	Number of Nematodes Per 100 cm^3 soil
Griffith	Healthy	90
Griffith	Diseased	38
Wilson	Healthy	8
Wilson	Diseased	32

TABLE 2. Comparison of Nematode Populations from Roots of Diseased and Healthy White Pine Seedlings at the Wilson and Griffith State Forest Nurseries.

Nursery	Diseased/Healthy	Number of Nematodes/gr Fresh Root Tissue
Griffith	Healthy	9
Griffith	Diseased	94
Wilson	Healthy	8
Wilson	Diseased	15

TABLE 3. Effect of Soil Fumigant and Cover Crop on Nematode Oppulations in the State Forest Nurseries of Wisconsin

Nursery	Cover Crop Prior to Fumigation	Fumigant and Rate of Application	Number of Samples Examined	Average Number of Nematodes per Sample
Hayward	Hydan[1]	Mylone 400#/Acre	4	29
Hayward	Buckwheat	Mylone 400#/Acre	4	9
Griffith	Hydan	Mylone 400#/Acre	3	43
Griffith	Hydan	MC-2 500#/Acre	3	1
Griffith	Hydan	Mc-2 500#/Acre	3	0
Griffith	Hydan	None	3	59
Wilson	Hydan	Mylone 400#/Acre	3	127
Wilson	Hydan	MC-33 300#/Acre	3	0.3
Wilson	Hydan	None	3	297

[1]Sorghum-sudangrass

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PROGRESS REPORT OF WORK COMPLETED DURING THE 1979 FIELD SEASON CONCERNING CUTWORM DAMAGE TO CONIFER SEEDLINGS

by
Marguerita A. Palmer and Thomas H. Nicholls[1]/

The Problem

Seedling damage at Hayward State nursery, Hayward, Wisconsin, was first observed in the mid 1960's. Then, it was of minor importance, however, in 1976 the damage became epidemic. From 1976 to 1978, John Borkenhagen, the nursery manager, estimates losing approximately one million seedlings per year, the total loss valued between $150,000-$200,000.

The cause of this damage was unknown. All conifer species were affected. Symptoms included cut or chewed cotyledons, primary needles, or stems of 1-year-old seedlings. Many times only part of the stem was left standing in the ground. This damage was tentatively labeled "bird peck" because the seedlings appeared as if a bird had nipped off the foliage or stem. Symptoms were also confused with seedling damage caused by damping off fungi. Fungicides were tried as a control without success.

In order to determine the cause of the damage, the affected seedbeds were studied starting in the early spring of 1979. This work was part of a combined effort of a S.W.A.T. Team that included Jane Zarnstorff and Allen Prey of the Wisconsin Department of Natural Resources as well as ourselves, Marge Palmer and Tom Nicholls, of the North Central Forest Experiment Station.

METHODS AND RESULTS

Observations and Isolations

In the spring of 1979, section J was the site of the most damage. On May 24, 1979, the sites of the most severe damage in the unit were marked and damaged 1-0 red pine seedlings were collected. Portions of these seedlings were surface sterilized and incubated in petri dishes on various mycological media to see if a fungal pathogen could be recovered. The majority of these isolations were sterile.

Late in the afternoon on May 31, 1979, a rainy and overcast day, the damaged seedlings in section J were observed again. Close inspection of the seedlings revealed cutworms feeding on the foliage, however, only one or two cutworms were observed. Cutworms are normally active only at night, so, that evening, the seedlings were again closely observed using flashlights. Many cutworms were observed devouring seedling foliage and thus were determined to be the cause of the damage.

Cutworms were collected to be reared to the adult stage in the laboratory for postive species identification. The cutworm was identified as *Feltia ducens* (dingy cutworm).

Using the same techniques, emerging red pine seedlings in unit J in the Griffith Nursery, Wisconsin Rapids, Wisconsin, were observed. Only a few cutworms and minor cutworm damage were observed. Cutworms were also observed by Wisconsin Department of Natural Resources personnel at Wilson Nursery, Boscobel, Wisconsin.

Chemical Control

A chemical spray was applied at Hayward Nursery on June 1, and June 6, 1979. Diazinon AG-500 at 4 qts. of product per 96 gallons of water was used. Before control measures were initiated, small plots were established to determine the effectiveness of the spray.

Seven bedrows in unit J were designated as spray areas. The remaining two bedrows were used as controls (unsprayed). In each of the sprayed and unsprayed areas, four 2-foot-long plots were established. The number of undamaged seedlings were counted in each plot, and each damaged seedling was tallied and marked with a toothpick.

The affected seedbeds were sprayed on June 1, and June 6, 1979. On June 12, 1979, the plots were observed to determine effectiveness of the sprays. The results of these observations are shown in Table 1. The results show that the spray was effective in controlling the cutworms.

On June 12, 1979, forty-five minutes were spent observing each of the sprayed and unsprayed plots after dark during the period when cutworms are active. No cutworms were observed feeding on seedlings in the sprayed plots, but eighteen cutworms were found on unsprayed seedlings. These observations reconfirmed the effectiveness of the chemical control.

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TABLE 1. Effectiveness of a Chemical Spray for Control of Cutworms on 1-0 Red Pine Seedlings in Section J, Hayward State Nursery, Hayward, Wisconsin

Treatment[a]	Number of trees in sample[b]	Number of seedlings damaged	
		Before spray	After spray
Sprayed[c]	186	35	0
Unsprayed	148	64	27

[a]Chemical used was Diazinon AG-500 at a rate of 4 quarts of product per 96 gallons of water.
[b]Total number of trees from two-foot plots replicated four times per treatment.
[c]Sprayed June 1 and June 6, 1979.

Stunting

Stunting of all species of 1-year-old conifer seedlings is a problem at all three of the Wisconsin State nurseries. Stunted seedlings appear to set bud earlier than non-stunted seedlings. To determine if cutworm feeding could be the cause of stunting, study plots were established in areas where cutworm damage had been observed in each of the three nurseries.

Each plot included four treatments, each one foot in length, that were designed to simulate different degrees of cutworm damage. The treatments were as follows: 1. using small scissors, half the length of all the foliage was cut off, 2. cotyledons only were cut off at the base, leaving the primary needles intact, 3. all of the foliage was cut off to the top of the stem, 4. untreated (control).

Ten of these plots were established in the red pine in section J, Hayward Nursery, and in red pine in section J in Griffith Nursery. Five plots were also established in the white spruce and in the white pine section K, Griffith nursery. Similar plots were established by Wisconsin Department of Natural Resources personnel in the Wilson Nursery, Boscobel, Wisconsin. All study areas were observed later in growing season.

CONCLUSIONS

I. Cutworms were identified as the cause of "bird peck". The nursery manager, John Borkenhagen, estimates that one million trees, valued at $58,000, were saved, as a result of the proper identification of the cause and quick chemical control.

II. Cutworms and cutworm damage was also observed at Griffith Nursery, Wisconsin Rapids, Wisconsin, but were not a serious problem. However, the potential for losses is present in these two nurseries, so they should be closely monitored in the spring for cutworm outbreaks and damage.

III. Plots were established simulating the different degrees of cutworm feeding to determine if cutworm feeding was related to stunting of seedlings. These plots did not demonstrate cutworms to be the cause of stunting.

PLANS FOR 1980

I. A leaflet entitled "How to Identify and Control Cutworm Damage in Conifer Seedling" will be published.

II. Areas with suspected cutworm damage will be verified and control measures recommended.

ACKNOWLEDGEMENTS

We would like to thank John Borkenhagen, Ken Wojhan, and Dick Camp, Wisconsin Department of Natural Resources for their excellent cooperation during these studies.

PROGRESS REPORT OF WORK COMPLETED DURING THE 1979 FIELD SEASON CONCERNING WHITE PINE ROOT ROT AT GRIFFITH NURSERY WISCONSIN RAPIDS, WISCONSIN

by
Marguerita A. Palmer and Thomas H. Nicholls[1]/

The Problem

Our responsibility was to examine the white pine affected with root rot at Griffith Nursery, Wisconsin Rapids, Wisconsin and Wilson Nursery, Boscobel, Wisconsin, in order to determine the cause of the disease. The majority of our studies were conducted at the Griffith Nursery. Here, extensive seedling mortality was observed in 2-0 white pine, section B. Three-year-old white pine from section F also showed symptoms of root rot. Later in the season, 1-0 white pine in section K began to exhibit symptoms of root rot.

Methods

Samples of diseased and healthy trees from Griffith Nursery were collected a total of seven times during the 1979 field season (5/4, 5/30, 6/15, 6/28, 8/15, 9/21 and 11/17). Detailed morphologic and anatomic examinations were made of the seedlings in addition to isolations from the roots. The number and condition of roots, plant height, condition of foliage, and presence or absence of root lesions and sclerotia were noted.

Results

A. Lesions were observed on the main roots of the 2-0 and 3-0 seedlings with both healthy appearing and chlorotic foliage. The lesions were generally longer on the seedlings with chlorotic foliage than on those seedlings with healthy appearing foliage.

B. Sclerotia were not observed on healthy or diseased 2-0 and 3-0 seedlings. All of the dead 1-0 seedlings from section K (mylone fumigated) had sclerotia of *Cylindrocladium floridanum* inbedded in the necrotic tissues on our last collection date on November 11.

C. Segments of the roots and stems of diseased 1-0, 2-0 and 3-0 seedlings were incubated on several types of mycological media. The results of these isolations are shown in the attached tables. *C. floridanum* was isolated from 1-0 and 2-0 stock. *Fusarium* spp. were isolated from all ages of seedlings. From most of the isolations, presumably saprophytic fungi such as *Penicillium* and *Aspergillus*, and sterile plates were obtained.

D. In addition to the isolation procedures, the root systems of all ages of healthy and diseased trees were washed, surface sterilized, and incubated in sterile petri dishes. Presumably saprophytic fungi such as *Penicillium* and *Aspergillus* in addition to *Fusarium* and *Verticillium* were recovered from both healthy and diseased 2-0 and 3-0 plants. These same kinds of fungi were obtained from the 1-0 white pine seedlings, however, *C. floridanum* was also obtained from approximately 50% of these root systems.

Discussion

Three possibly pathogenic fungi were recovered from isolations of root tissue of diseased white pine seedlings. *Rhizoctonia*, *Fusarium* and *Cylindrocladium* were recovered as well as many other fungi that may be pathogens or organisms of secondary action. The recovery of *Cylindrocladium* is especially interesting because in the 1960's this fungus was the cause of a root rot of white pine at Griffith Nursery and at the Chittenden Nursery in Michigan. At the Chittenden Nursery, it caused a root rot of white pine but not on the red pine growing in the same section. Also, researchers found it difficult to isolate *Cylindrocladium* from white pine seedlings including those that had dried in soil inoculated with pure cultures of the fungus. These situations are similar to those found in the Griffith Nursery. Thus, it is possible that *Cylindrocladium* may be the cause of the present root rot of white pine at this nursery even though it was not recovered from the majority of the isolations. Work in 1980 will try to determine if this is true.

There may also be a fungus that was not recovered in our isolations or another disease agent such as nematodes that is causing the white pine root rot.

Conclusion

The cause of this desease has not yet been established and further work is needed to determine the causal agent(s) and control methods.

Plans for 1980

The study area established by K. Wojhan, Nursery Manager at Griffith Nursery will be systematically sampled throughout the 1980 field season. Also, the 1-0 white pine in section K that began to show symptoms of root rot last season will be sampled again this year. Sampling intensity will be increased during the spring when *Cylindrocladium* is thought to be the most active.

Laboratory tests will be done with *Cylindrocladium* to determine if the fungus is becoming resistant to mylone or whether the mylone concentration used in the nursery was high enough to kill this fungus.

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Table 1. Results of Root Isolations of 37 Diseased 1-0 White Pine Seedlings from Section K, Griffith Nursery, Wisconsin Rapids, Wisconsin, 1979

Fungus	Sampling dates - 8/15, 9/12, 11/7 Trees	Isolations[a]
	Percent	Percent
Rhizoctonia spp.	0	0
Trichoderma spp.	28.1	6.7
Cylindrocladium floridanum	23.4	8.1
Fusarium spp.	24.0	8.3
Unknown	54.6	15.0
Other organisms[b]	74.7	33.0
Sterile	64.1	28.9

[a]Czapek's agar, corn meal agar, Rose Bengal agar, PDA with streptomyacin, and PCNB media used, approximately 15 isolations per tree.
[b]*Penicillium* spp., *Aspergillus* spp., *Alternaria* spp., *Pestilotia* spp., *Talaromyces vermiculatus, Verticillium* spp., and bacteria.

Table 2. Results of Root Isolations of Deseased 2-0 White Pine Seedlings Collected on 7 Samplings Dates From Section B, Griffith Nursery, Wisconsin Rapids, Wisconsin, 1979

Fungus	Sampling dates 5/4 - 8/15 Trees	Isolations[a]	Sampling dates 9/12 and 11/7 Trees	Isolations[b]
	Percent	Percent	Percent	Percent
Cylindrocladium floridanum	0	0	5.0	0.7
Trichoderma spp.	5.5	0.4	0	0
Rhizoctonia spp.	15.3	1.7	0	0
Fusarium spp.	33.7	6.4	16.5	2.2
Unknown	37.6	7.3	42	8.1
Other organisms[c]	94.4	41.1	100	59.4
Sterile	92	43.1	83.5	29.6
Total number of trees		69		19

[a]APDA and PCNB meida used, 12 isolations per tree.
[b]Czapek's agar, corn meal agar, Rose Benzal agar, PDA with streptomyacin and PCNB media used, approximately 15 isolations per tree.
[c]*Pinicillium* spp., *Aspergillus* spp., *Alternaria* spp., *Pestilotia* spp., *Talaromyces vermiculatus, Verticillium* spp., and bacteria.

Table 3. Results of Root Isolations of 30 Diseased 3-0 White Pine Seedlings From Section F, Griffith Nursery, Wisconsin Rapids, Wisconsin, 1979

Fungus	Sampling date - 8/15 Trees	Isolations[a]
	Percent	Percent
Rhizoctonia spp.	0	0
Trichoderma spp.	0	0
Cylindrocladium floridanum	0	0
Fusarium spp.	0.07	1.3
Unknown	50.0	13.1
Other organisms[b]	93.3	36.0
Sterile	80.0	49.6

[a]PCNB and APDA media used, 12 isolations per tree.
[b]*Penicillium* spp., *Aspergillus* spp., *Talaromyces vermiculates, Berticillium* spp., *Pestilotia* spp., and bacteria.